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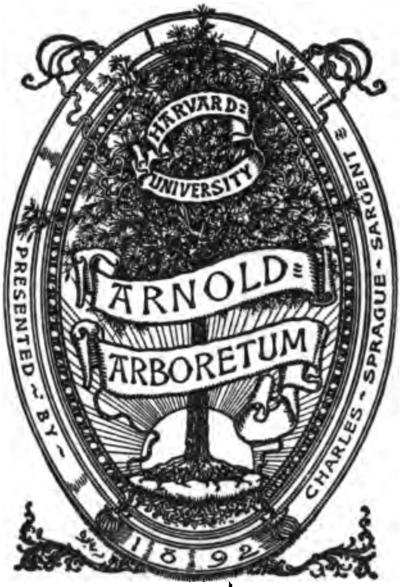

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A PRELIMINARY WORKING PLAN FOR THE PUBLIC FOREST TRACT OF THE INSULAR LUMBER COMPANY, NEGROS OCCIDENTAL, P. I.

BY

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BULLETIN NO. 5

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CONTENTS.

Page.

Letter of transmittal 3
Introduction 9

Part I.—*Statement of the facts upon which the working plan is based.*

General description of the tract 11
  Situation and area 11
  Boundaries 11
  Physiography 12
  Soil and underlying rock 12
  Climate 12
  Roads and trails 13
  Social and economic conditions 13
  Ownership of the land 14
The composition and condition of the forest 14
  Characteristic types 14
    Waste land type 15
    River valley type 15
    Upland forest type 15
  Stand and yield of upland forest 19
    Stand 19
    Volume tables 21
    Yield 22
  Description of trees 25
    Principal species 25
      Apitong 25
      Almon 25
      Balacbacan 26
      Mangachapuy 27
      Lauan-dunlog and Lauan-bagtican 27
    Minor tree species 28
  Injuries to which the forest is liable 29
    Damage from natural causes 29
    Damage from artificial causes 30
The utilization of the forest 32
  Timber 32
    History of lumbering 32
    Present lumbering operations 33
      General conditions 33
      Logging 34
      Waste and injury to the forest 36
      The sawmill 38
      Cost of lumbering 39
      Markets and transportation 40
      Prices and Government charges 40
      Prospects 41
  Minor forest products 41
Agricultural possibilities of the land 42

PART II.—*Future management.*

Page.
Basis of proposals 45
  Relation between owner and licensee 45
  Division of the forest into blocks 45
  Summary of merchantable stand and yield 47
Method of treatment 47
  Object to be attained 47
  Method of treatment adopted 47
  Exploitable size 47
  The logging 48
    Cutting areas 48
    General cutting rules 48
    Additional cutting rules for agricultural land 49
    Additional cutting rules for forest land 49
Supplementary recommendations 49
  General management 49
  Protection 50
  Revision 51
Administration 51

APPENDIX.

List of tree species 53

ILLUSTRATIONS.

PLATES.

		After page
PLATE I.	Cutting a large Almon tree. (Frontispiece.)	
II.	Mangachapuy seedlings in the forest	16
III.	Clearing on logged land	24
IV.	Characteristic caiñgins under rude cultivation	28
V.	Hauling engine at the landing	30
VI.	Bridge on the hauling road	32
VII.	Yarding engine at the end of the hauling road	34
VIII.	Cutting up a large Mangachapuy tree	36
IX.	Forest in good condition after logging	40
X.	Forest in poor condition after logging	42
XI.	General view of the sawmill site	46
XII.	Sawmill of the Insular Lumber Company	50

MAP.

Map of the forest tract on the Himugaan River, Negros Occidental, P. I., operated under a twenty-year license agreement by the Insular Lumber Company. (Insert.)

A PRELIMINARY WORKING PLAN FOR THE PUBLIC FOREST TRACT OF THE INSULAR LUMBER COMPANY, CADIZ, NEGROS OCCIDENTAL, P. I.

INTRODUCTION.

The following working plan has been prepared:

First. To furnish a prescribed plan for the regulation and management of the large tract of public forest in the Island of Negros granted to the Insular Lumber Company for a period of twenty years.

Second. To secure accurate information concerning the timber of an important forest region of the Philippine Islands.

Third. To give the native rangers employed in the Bureau of Forestry needed training in forest field work.

Field work was begun May 1, 1906, and completed June 15, 1906. Two foresters, one assistant forester, three native rangers, and a constantly changing force of six to fifteen laborers were engaged in the work. Owing to the short time available for the field work, some interesting information was not secured which would add to the completeness and detail of the report.

The field work divided itself into three parts: First, forest map; second, botanical survey; third, collection of data for forest management.

There were made 135 acres of valuation surveys of standing timber, 15 reproduction plots, volume measurements of 57 felled trees, measurement of area logged, valuation surveys in logged area, sylvicultural studies of the principal species, a study of the logging operation, collection of log specimens of the principal species, and a general botanical collection of trees and other plants growing on the tract.

Two base lines were run through the concession 8 kilometers long and 5 kilometers apart, with stations marked every one-half kilometer. Then from each kilometer station, valuation survey lines were run east and west of the base line. The trees 5 meters, or one rod, each side of these survey lines were calipered as nearly as possible at the point just above the main buttresses. In this manner about 29 per cent of the total area of the tract was surveyed with the actual measurement of the trees on 1 per cent of this area. The figures for stand of timber in the report are based on this measurement. Since the merchantable forest on the tract is remarkably uniform in composition and density, it is believed that the figures can be applied to the entire area of upland or merchantable forest. However, it is better to confine their application to the area lying between the Himugaan and Hitalon Rivers, where the surveys were made.

This working plan is provisional only and should be revised as soon as complete data in regard to the tract is secured. It will serve as a guide for the next few years while the Insular Lumber Company is initiating extensive operations. As much field work as possible should be done on the tract each year, with the revision of the plan in mind.

PART I.

STATEMENT OF THE FACTS UPON WHICH THE WORKING PLAN IS BASED.

GENERAL DESCRIPTION OF THE TRACT.

SITUATION AND AREA.

The tract of the Insular Lumber Company is situated in the municipalities of Cadiz and Sagay, Province of Negros Occidental, Island of Negros, P. I., approximately in latitude 10° 50′ north and longitude 123° 30′ east of Greenwich. Its area is 69 square miles, or 44,160 acres (18,000 hectares), of which approximately 39,660 acres (16,060 hectares) are forested and the remaining 4,500 acres cultivated, waste land, and recent clearings. The tract lies on the lower slopes of Mount Silay, just back of the coastal strip of sugar lands, here about 6 miles wide, and consists of two adjoining parts, the upper and smaller of which lies to the south of the lower along the Himugaan River. It is a part of the large and similar forest which extends from Escalante to Silay, some 50 miles, lying 6 to 15 miles back from the coast and extending far into the interior. In some places, as on the Himugaan River, it occupies rolling and hilly lands, and in others, as near Silay, it has been driven back to the steep foothills.

BOUNDARIES.

Lower tract.—Beginning at a point on the left bank of the Himugaan River, at the mouth of Lumbunao Creek, about 6 miles south of the coast line; thence the boundaries run east-southeast for about 6 miles to a point 1 mile due south of Baobao Hill; thence south-southwest 5 miles; thence west-northwest 12 miles; thence north-northeast 5 miles; thence east-southeast 6 miles to the starting point; in all, an area of 60 square miles.

Upper tract.—Beginning at a point on the southern boundary of the lower tract, 1½ miles east-southeast of the Himugaan River, the boundaries run south-southwest 3 miles; thence west-northwest 3 miles; thence north-northeast 3 miles; thence east-southeast along the southern boundary of the lower tract to the starting point; in all, an area of 9 square miles.

The boundary lines are not marked in any way. They are bordered by dense forest on the east, south, and west, and by alternating patches of forest, waste land, and cultivated land on the north.

PHYSIOGRAPHY.

The land is characterized by gentle slopes, with alternating ridges at the base of Mount Silay. The elevation ranges from 100 feet at points on the northern boundary to 1,200 feet at the highest point on the southern boundary. Small streams and arroyos are scattered profusely over the tract.

Four large rivers drain the tract and small tributary streams are numerous. The Himugaan River, flowing in a deep, winding valley through the middle, drains about 65 per cent of the area. It is the largest of the four rivers and is navigable by small steamers as far as the company's sawmill, about 6 miles from its mouth. The Hitalon and Talabon Rivers drain the extreme western and the Tanao River the eastern parts of the tract.

SOIL AND UNDERLYING ROCK.

The rock and soil are practically uniform throughout the tract. The former is a black igneous rock, which rapidly disintegrates, forming a deep, stiff clay soil, brown in color. The soil is evidently fertile, as it yields good crops of corn and sugar cane where it is now under cultivation. The rock outcrops along the streams and frequently occurs as bowlders on the surface of the ground.

CLIMATE.

The climate of this region is tropical. Extreme heat, however, is moderated by the influence of the surrounding waters and by the cool sea breezes which blow almost constantly. These are the northeast monsoon, which prevails from about June to November 1, and the southwest monsoon, from November 1 to June 1, with short periods of variable winds at the times when the monsoons change. The coolest time of year is from November to March, and the hottest from March to June. The following table gives the average monthly maximum and minimum temperatures for 1903 at Bacolod, Negros Occidental. They are probably slightly higher than they should be for the immediate neighborhood of the tract:

Table I.—*Temperature at Bacolod, Negros Occidental, 1903.*

Month.	Average monthly temperature.		Month.	Average monthly temperature.	
	Maximum.	Minimum.		Maximum.	Minimum.
	°*F.*	°*F.*		°*F.*	°*F.*
January	86	72.6	July	86.8	73.8
February	85.6	71.8	August	87.8	73.2
March	88.5	70.5	September	86.8	73.2
April	91.6	73	October	86.5	73.4
May	91.8	74.6	November	87	73.8
June	88.8	74.6	December	85	73.2

There are two general seasons, wet and dry. From January 15 to May 15 the weather is dry, although showers are often frequent during the latter part of January and the beginning of May. From May 15 to January 15 it is generally wet, with the greatest amount of rainfall in July, September, and October. The following table of monthly rainfall in Bacolod, Negros Occidental, and in Iloilo, Iloilo, is applicable in a general way to this tract, although it is important to remember that the northeast monsoon, bearing rain at the time most needed, strikes with more force on the north and northeast coast of Negros, where the tract is situated, than at Bacolod or Iloilo, and hence the dry season is probably considerably less pronounced than it is at Bacolod. The vegetation is, in consequence, much more luxuriant than in parts of the Islands where the dry season is more extended. In the forest in question the trees are not without leaves at any time of the year. In other words, it is a typical evergreen tropical forest:

TABLE II.—*Rainfall.*

Month.	Iloilo, Iloilo.		Bacolod, Negros Occidental.	
	1903.	1905.	1903.	1905.
	mm.	*mm.*	*mm.*	*mm.*
January	5.5	2.8	51.3	31.4
February	1.5	3.9	13	3.1
March	3.3	0	6.3	1.6
April	4.8	32.4	2.8	1.1
May	165.6	60.7	91.3	112.1
June	244.3	175.8	178.1	145.9
July	427	608.1	334.6	388.7
August	186.2	277.5	200.2	425.5
September	146.3	148.8	298.4	227.6
October	245.6	342.8	223.3	362.5
November	124.5	60.6	149.7	165.5
December	528.3	48	429.2	158.7
Total (millimeters)	2,082.9	1,761.4	1,978.2	2,023.7
Total (inches)	82	69	78	80

ROADS AND TRAILS.

The tract is crossed by numerous foot and carabao trails, generally running in a north and south direction. They are used for the transport of bejuco and poles from the forest, and should be useful in the management and protection of the tract. Outside of the forest they unite with the main trails or roads leading to the towns and barrios on the coast. These are uniformly bad foot and horse trails, almost impassable in the rainy season.

SOCIAL AND ECONOMIC CONDITIONS.

The Filipinos of the region are Visayans, who live on the cleared land along the coast but seldom in the forest, and a few roaming families of Negritos in the interior. About forty-five Visayan families, exclusive of the employees of the company, live within the tract, nearly all of whom are in its northwest corner and in the valley of the Himugaan River. They live on small farms or caiñgins, 5 to 50 acres in area, on which they grow corn, tobacco, and camotes. Generally they are also collectors of bejucos, which they sell in the neighboring sugar haciendas or in the coast towns.

The chief occupations of the people of the coastal strip of cleared land are fishing and farming. The principal agricultural products are sugar, corn, and tobacco. Sugar is grown on large estates, or haciendas, and requires considerable capital for its cultivation. Corn and tobacco are mostly grown by the poorer people on small farms or caiñgins. Owing to losses during the revolution and insurrection and to the destructive epidemic among the draft animals, many farms are abandoned at the present time. Nevertheless, the country is well settled. The municipality of Cadiz had a population of 16,429 and Sagay of 8,311 persons by the census of 1903. In general intelligence and industry the population is equal to that of any other agricultural region in the Islands.

The forest needs of the population are limited. The mangrove swamps on the coast supply most of the necessary firewood and small timbers. From the mountain forests they gather bejucos, vines, resins, palm leaves, small poles, and a few large trees, from which they shape their bancas, or dugouts. For their legitimate personal needs, which should be satisfied, an insignificant amount of forest products is required from the tract.

OWNERSHIP OF THE LAND.

The timbered area of the tract, comprising 39,660 acres, is public land. All of the remaining 4,500 acres of cultivated and waste lands are either owned or claimed by private persons. Their titles or claims are based principally on possession. In no known case has any title to this land been registered in the Court of Land Registration. However, the claims should be recognized as far as possible and all residents left in possession of the land which they now occupy.

THE COMPOSITION AND CONDITION OF THE FOREST.

CHARACTERISTIC TYPES.

On the tract there are three characteristic vegetative types. They are as follows: Waste-land type, river-valley forest type, and upland forest type. The two latter are natural, the first is the result of clearings made in the forest types.

WASTE-LAND TYPE.

In the Philippines the vegetation that occupies clearings or partial clearings has the general Tagalog name of "parang."[1] The kind of woody vegetation that springs up quickly in clearings is known by the Tagalogs as "calaanan" and by the Visayans as "laté," and is merely a subtype of the "parang." The "parang," or waste-land type, together with a small amount of cultivated land, comprises about 4,500 acres. A greater part of this is occupied by the "laté," the vegetation of which is composed of quick-growing weed trees that have little or no value. The following species are the most characteristic: *Trema amboinensis* Blume (Janagdon), *Psidium guayava* L. (Bayabas), *Homalanthus populneus* Pax. (Balanti), *Mallotus ricinoides* Muell. (Himlaamo), *Breynia rhamnoides* Muell. (Tulugtulug), *Ficus hauili* Blanco (Labnug), *Musa* sp. (Wild hemp), and many others. This type is only temporary and if protected from fire will gradually return to the original forest condition.

RIVER-VALLEY TYPE.

At the lower limits of the tract the Himugaan River is winding and distinct terraces have been formed. As the stream is ascended these terraces become more narrow until finally on the upper half of the tract they disappear entirely, the river itself occupying a deep, narrow canyon. The terraces are valuable for agricultural purposes and, as shown by the map, the original forest has been cleared from a large portion of them. Probably there are 2,000 acres that are still in original forest. This estimate, which is liberal, includes the forest on the terraces near the mouths of the principal branches. A hurried examination of this type shows it to be in a poor sylvicultural condition. It is characterized by many species, most of which are small, crooked, and defective. The undergrowth is a dense mass of climbing bamboo, bejucos (rattan), wild hemp, vines, and shrubs. The commercial unimportance of the trees makes it doubtful if the Insular Lumber Company will ever find it advisable to log them. The land is better suited for agricultural than for forest purposes, consequently it may be found best to grant homesteads and permit caiñgins on it without consideration of the present forest growth.

UPLAND FOREST TYPE.

The commercial forest of the tract is of the upland type and has an area of about 37,600 acres (15,200 hectares), or 85 per cent of the entire tract. The merchantable timber which is being lumbered is on this type. The upland forest type, ranging from 150 to 1,200 feet elevation, covers the broad gentle slopes and ridges which lead up to the foothills and peaks of Mount Silay. The slopes are cut up by a number of small streams and numerous arroyos.

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[1] See Vidal, D. Sebastian: Catálogo Metódico de las Plantas Leñosas Silvestres y Cultivadas observadas en la Provincia de Manila (1880), 9–10, for the original definition of "parang;" also H. N. Whitford: The Vegetation of the Lamao Forest Reserve, *Phil. Journ. Sci.* (1906), **1**: 388–398, and W. W. Maule: Parang and Cogonales in the Philippines, *Forestry and Irrigation* (1906), **12**: 311–317, for more detailed accounts of "parang" vegetation.

The forest itself is characterized by a numerous dominant stand of large over-mature trees belonging to the family *Dipterocarpaceæ,* with an undergrowth of many small trees, making a forest remarkable for its density and yield.

The dominant trees important numerically and commercially are six in number, all Dipterocarps. They are Apitong (*Dipterocarpus grandiflorus* Blanco), Almon (*Shorea squamata* Dyer), Balacbacan (*Shorea polysperma* Merr.), Mangachapuy [2] (*Shorea* sp.), Lauan-dunlog (*Shorea contorta* Vid.) and Lauan-bagtican (*Shorea* sp.). Of the 32.9 trees per acre 40 centimeters (16 inches) and over in diameter, 29.4, or nearly 90 per cent, are the above species. They occur well mixed on every acre of upland forest. The average diameter of trees 40 centimeters and over is 71 centimeters (28 inches). The largest is Mangachapuy and the smallest Apitong. They are all tall, clear trees, with large buttresses, which attain a diameter of more than 150 centimeters (60 inches), a height of more than 60 meters (200 feet), and sometimes have a clear length of 30 to 40 meters (100 to 130 feet).

The minor species, though they occur in large numbers, are too small and too varied in quality to be of any great importance commercially. The average diameter of trees 40 centimeters and over is 49 centimeters (19 inches). Those which occur in largest numbers and for which a commercial use may be found are Ata-ata (*Diospyros* sp.), Dungula (*Vitex aherniana* Merr.), Guisoc-guisoc (*Hopea philippinensis* Dyer), Bulog (*Eugenia* sp.), and Moabog (*Canarium* sp.).

On the banks of small streams and in arroyos there is usually a very narrow fringe of small, unimportant trees. Here certain species are uniformly found. The most common are *Astronia cumingiana* Vid. and *Kayea* sp.

The upland forest, compared to most tropical timber forests, is lacking in dense underbrush. (Pl. II.) Climbing bamboos, bejucos, palms, and vines are regularly distributed through the forest, but only in a few spots, where an opening has been made admitting the light, do they form dense tangles, almost impossible to penetrate. As a rule, one can travel easily and steadily through the forest, cutting an occasional bamboo or bejuco from the path. The most common plants in the undergrowth are a *Pandanus* sp., bejucos, palms, climbing bamboos and vines, and numer-

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[2] It should be stated here that this species is not the Mangachapuy of commerce.

PLATE II. MANGACHAPUY SEEDLINGS IN THE FOREST. (NOTE DENSITY OF FOREST GROWTH.)

ous shrubs of the families *Rubiaceæ, Euphorbiaceæ, Melastomaceæ,* and others.

The heavy shade prevents a dense herbaceous growth in the ground cover. The most common plants are vines, herbaceous plants and seedlings of trees, bejucos, and palms. The characteristic species are a *Pandanus* sp. and a large sedge (*Mapania humilis* Naves).

The ground itself is remarkably free from litter. Heavy rains, insects, and fungi rapidly remove débris from the ground, leaving the soil bare, except for the scanty growth of small plants.

The silvical condition of the forest is bad. Most of the dominant trees are over mature and almost invariably diseased. The forest is balanced between growth and decay, with a big annual loss of increment which should be utilized. The mature and over mature trees should be removed as soon as possible to reduce the loss to a minimum and to enable the production of a second timber crop through the growth of the small trees and seedlings, which are abundant in the forest.

Reproduction of the tree species is abundant and well distributed in the upland forest. (Pl. II.) There is a regular assortment of seedlings, saplings, small poles, large poles, and small trees to take the place of the large trees as they drop out. The deep shade beneath the large trees aids germination by keeping down a rank suffocating growth of vines, herbs, and grasses, which spring up in abundance in openings. On the other hand, this lack of light makes it difficult for the seedlings and saplings to survive and grow. Only a few of the millions of seedlings in the virgin forest finally reach a size where growth to maturity is practically assured. In short, the ground is usually a good seed bed. Seedlings of all species are sufficiently abundant and well distributed. Few seedlings reach the pole size, but enough do so to provide for the future of the forest.

The six principal species are well represented in the reproduction and evidently will continue to predominate in the forest in about the same proportions as in the past. They appear to seed periodically and abundantly. Seedlings of Mangachapuy and Almon are especially abundant at present, pointing to a recent heavy seeding of those species. The seeds of all appear to have germinated well. The seedlings endure considerable shade, and poles and small trees of all are present in satisfactory numbers. The advantage in shade endurance and persistency of growth under unfavorable conditions seems to lie with the Apitong and Almon.

Table III gives the total number of seedlings and saplings of trees and all other plants entering into the underbrush and ground cover ascertained by actual count on 15 plots, of one square rod each, regularly distributed through the upland forest in block 4.

TABLE III.—*Tree reproduction and ground cover on 15 square rods (375 square meters).*

Scientific name.	Common name.	Seedlings.	Saplings.
Dipterocarpus grandiflorus	Apitong	4	5
Shorea squamata	Almon	169	7
Shorea polysperma	Balacbacan	41	5
Shorea sp	Mangachapuy	896	1
Hopea philippinensis	Guisoc-guisoc	8	2
Vitex aherniana	Dungula	1	6
Diospyros sp	Ata-ata	19	6
Other tree species		57	20
Palmæ[a]	Palms	155	50
Calamus spp	Bejucos, or rattans	45	39
Pandanus sp	Pandan	29	1
Mapania humilis	Sedge	215	
Unknown plants[b]		583	65
Dinochloa sp	Climbing bamboo	([c])	([c])
Total		2,222	207

[a] Species of the genera Livistona, Pinanga, Oncosperma, and others.
[b] Mostly vines, some trees, with a few herbs and ferns.
[c] Abundant but not counted.

Table IV gives the average number per acre and hectare of poles and small trees of the six principal species, based on valuation surveys of 135 acres of upland forest in blocks 3, 4, 5, and 6.

TABLE IV.—*Stand of the small trees of the six principal species.*

Diameter above buttresses.		Stand per acre.					
Inches.	Centimeters.	Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.
4.7- 7.5	12–19	3.43	3.47	1.01	1.29	0.65	9.85
7.9–11.4	20–29	3.89	3.34	1.56	1.81	1.14	11.74
11.8–15.7	30–39	2.18	1.86	.94	.94	.56	6.48
Total		9.50	8.67	3.51	4.04	2.35	28.07
Percentage		33.8	30.9	12.5	14.4	8.40	100

Diameter above buttresses.		Stand per hectare.[a]					
Inches.	Centimeters.	Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.
4.7- 7.5	12–19	8.47	8.58	2.51	3.18	1.61	24.35
7.9–11.4	20–29	9.61	8.25	3.86	4.48	2.82	29.02
11.8–15.7	30–39	5.38	4.59	2.32	2.32	1.39	16
Total		23.46	21.42	8.69	9.98	5.82	69.37

[a] 1 hectare = 2.471 acres.

Silvical treatment of the upland forest for its perpetuation and the production of timber is not difficult. The composition of the forest and the sylvics of the trees render a selection system of cutting, with protection of the reproduction, safe and certain to secure the desired results.

STAND AND YIELD OF UPLAND FOREST.

The merchantable timber on the concession is practically all in the 37,600 acres of upland forest, which is about 85 per cent of the total area of the tract. The valuation surveys and other measurements made to determine the volume of merchantable timber were confined to this type of forest. It is this type that the company will log, and to it that the chief provisions of the working plan apply.

STAND.

One hundred and thirty-five acres of the timber land in blocks 3, 4, 5, and 6 (mostly in 4 and 5), between the Hitalon and Himugaan Rivers, were surveyed and the trees classified and measured according to species and diameter outside of the bark just above the main buttresses. From this data Tables V, VI, and VII were constructed, showing the average number of trees per acre and hectare. Although the surveys were made in a part of the tract comprising but 29 per cent of the total area, owing to the homogeneous character of the forest and the conservative nature of the figures, it is believed that they can be applied to the entire area of upland forest without serious error. It is safer, however, to confine their application to blocks 3, 4, 5, and 6.

Tables V, VI, and VII show the number of merchantable trees per acre and per hectare—that is, trees 40 centimeters and over in diameter. The six principal species are separated, except the two Lauans, which are comparatively few and nearly alike in all respects. The scarcity of the other species makes it inadvisable to separate them in this table. A tree 16 inches in diameter, besides its use for sawn lumber, will also serve for railroad ties and skids in road construction.

Table V.—*Number of trees per acre 40 centimeters and over in diameter.*

[Average of 135 acres in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.	Other species.	Grand total.
Inches.	Centimeters.								
16	40	1.303	0.800	0.548	0.652	0.400	3.703	1.185	4.888
18	45	1.334	.792	.518	.496	.260	3.400	.970	4.370
20	50	.933	.622	.446	.526	.185	2.712	.526	3.238
22	55	.740	.511	.303	.474	.170	2.198	.260	2.458
24	60	.763	.474	.385	.422	.111	2.155	.148	2.303
26	65	.659	.407	.429	.466	.140	2.101	.126	2.227
28	70	.451	.326	.266	.422	.133	1.598	.066	1.664
30	75	.446	.303	.237	.400	.096	1.482	.059	1.541
31	80	.260	.378	.223	.437	.074	1.372	.066	1.438.
33	85	.244	.355	.244	.370	.059	1.272	.037	1.309
35	90	.207	.185	.185	.281	.052	.910	.022	.932
37	95	.103	.133	.126	.318	.052	.732	.015	.747
39	100	.059	.207	.163	.289	.089	.807	.007	.814

TABLE V.—*Number of trees per acre 40 centimeters and over in diameter*—Continued.

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.	Other species.	Grand total.
Inches.	Centimeters.								
41	105	0.126	0.260	0.111	0.446	0.082	1.025	0.007	1.032
43	110	.052	.170	.066	.393	.029	.710	----------	.710
45	115	.015	.155	.052	.289	.037	.548	----------	.548
47	120	.022	.163	.066	.370	.022	.643	----------	.643
49	125	.022	.044	.066	.274	.015	.421	----------	.421
51	130	.015	.044	.074	.237	.029	.399	----------	.399
53	135	.007	.066	.037	.215	.022	.347	----------	.347
55	140	----------	.066	----------	.281	.007	.354	----------	.354
57	145	.007	.037	.022	.103	----------	.169	----------	.169
59	150	----------	.037	.015	.118	----------	.170	.007	.177
61	155	----------	----------	----------	.052	----------	.052	----------	.052
63	160	----------	.007	.007	.096	.007	.117	----------	.117
65	165	----------	----------	----------	----------	----------	----------	----------	----------
67	170	----------	.007	----------	.030	----------	.037	----------	.037
Total ----------		7.768	6.549	4.589	8.457	2.071	29.434	3.501	32.935
Percentage---		23.6	19.9	13.9	25.7	6.3	89.4	10.6	100

TABLE VI.—*Number of trees per hectare*[a] *40 centimeters and over in diameter.*

[Average of 54.65 hectares in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.	Other species.	Grand total.
Inches.	Centimeters.								
16	40	3.22	1.98	1.85	1.61	0.99	9.15	2.92	12.07
18	45	3.29	1.96	1.28	1.22	.64	8.39	2.40	10.79
20	50	2.30	1.54	1.10	1.30	.46	6.70	1.30	8.
22	55	1.83	1.26	.75	1.17	.42	5.43	.64	6.07
24	60	1.88	1.17	.95	1.04	.27	5.31	.36	5.67
26	65	1.63	1	1.06	1.15	.35	5.19	.31	5.50
28	70	1.11	.81	.66	1.04	.33	3.95	.16	4.11
30	75	1.10	.75	.59	.99	.24	3.67	.14	3.81
31	80	.64	.93	.55	1.08	.18	3.38	.16	3.54
33	85	.60	.88	.60	.91	.14	3.13	.091	3.221
35	90	.51	.46	.46	.69	.13	2.25	.054	2.304
37	95	.25	.33	.31	.78	.13	1.80	.037	1.837
39	100	.14	.51	.40	.71	.22	1.98	.018	1.998
41	105	.31	.64	.27	1.10	.20	2.52	.018	2.538
43	110	.13	.42	.16	.97	.071	1.751	----------	1.751
45	115	.037	.38	.13	.71	.091	1.348	----------	1.348
47	120	.054	.40	.16	.91	.054	1.578	----------	1.578
49	125	.054	.11	.16	.68	.037	1.041	----------	1.041
51	130	.037	.11	.18	.59	.071	.988	----------	.988
53	135	.018	.16	.091	.53	.054	.853	----------	.853
55	140	----------	.16	----------	.69	.018	.868	----------	.868
57	145	.018	.091	.054	.25	----------	.413	----------	.413
59	150	----------	.091	.037	.29	----------	.418	.018	.436
61	155	----------	----------	----------	.13	----------	.13	----------	.13
63	160	----------	.018	.018	.24	.018	.294	----------	.294
65	165	----------	----------	----------	----------	----------	----------	----------	----------
67	170	----------	.018	----------	.074	----------	.092	----------	.092
Total----------		19.158	16.178	11.32	20.854	5.114	72.624	8.626	81.25

[a] 1 hectare = 2.471 acres.

Table VII.—*Number of trees of the six principal species 12 centimeters (4.7 inches) and over in diameter.*

[Average of 135 acres (54.65 hectares) in blocks 3, 4, 5, and 6.]

	Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauan-bagtican and Lauan-dunlog.	Total.
Per acre	17.26	15.22	8.11	12.50	4.42	57.51
Per hectare	42.6	37.6	20	30.8	10.9	141.90
Percentage	30	26.5	14.1	21.7	7.7	100

VOLUME TABLES.

To ascertain the volume of the timber in these trees and on each acre, measurements of 57 felled trees of Apitong, Mangachapuy, Almon, and Balacbacan were made. The following measurements were taken: Height of stump, diameter outside the bark on the stump, diameter outside the bark every 5 meters as far as the tree was merchantable, thickness of bark, and the clear length of the tree. The diameter on the stump is in nearly all the trees the point where the large buttresses end, and corresponds with the diameters measured in the valuation surveys. The total length could not be measured because of the great breakage of the tops in falling, which would have made such measurements too uncertain. A 5-meter log section in measuring the diameter was found very convenient, as it is equivalent to 16 feet, the standard log length.

From the measurements of the 57 trees, the volume of each in cubic meters and in feet, board measure, by the Doyle rule, was computed. Since so few trees were measured, it was not advisable to make a separate volume curve and table for each species. They happen, however, to have a similar habit of growth, being all large, clean-boled trees, with small taper. Consequently, all measurements were combined to make one volume curve in cubic meters and one in feet, board measure, to be applicable to all of the principal species. The following volume table was constructed from the volume curves. In this table no allowance is made for defects in logs that are merchantable, but unmerchantable logs were not measured. Allowance for defects in individual trees can not be made from the data collected. Small trees are usually very slightly defective, while large trees are almost always attacked by heart rot.

The tree in the United States which most closely resembles in shape and volume the large Dipterocarps on the tract is the Yellow Poplar (*Liriodendron tulipifera* L.). The actual number of board feet sawed out of Yellow Poplar trees of the different diameters is given in Table VIII for purposes of comparison.[3] The Dipterocarps are more defective than the Yellow Poplar, and allowance for these defects will overcome the difference in their favor shown in the table.

TABLE VIII.—*Volume table for the six principal species, based on measurements of 57 trees,*[a] *compared with Yellow Poplar.*[b]

Diameter above buttresses.		Apitong, Almon, Balacbacan, Mangachapuy.		Yellow Poplar (feet B. M).	Diameter above buttresses.		Apitong, Almon, Balacbacan, Mangachapuy.		Yellow Poplar (feet B. M).
Inches.	Centimeters.	Feet B. M., Doyle rule.	Cubic meters.		Inches.	Centimeters.	Feet B. M., Doyle rule.	Cubic meters.	
16	40	150	1.12	191	43	110	3,950	13.18	3,146
18	45	250	1.50	276	45	115	4,400	14.50	3,470
20	50	400	2	380	47	120	4,950	16	3,801
22	55	580	2.50	507	49	125	5,550	17.46	4,144
24	60	800	3.18	657	51	130	6,100	19	4,497
26	65	1,050	3.84	832	53	135	6,550	20.40	4,844
28	70	1,310	4.60	1,085	55	140	6,900	21.70	5,154
30	75	1,600	5.40	1,250	57	145	7,200	22.80	5,485
31	80	1,880	6.26	1,359	59	150	7,450	23.70	5,700
33	85	2,200	7.27	1,585	61	155	7,630	24.40	5,944
35	90	2,500	8.40	1,832	63	160	7,780	25	6,174
37	95	2,820	9.40	2,149	65	165	7,900	25.50	6,394
39	100	3,150	10.57	2,478	67	170	8,000	25.80	6,604
41	105	3,500	11.80	2,827					

[a] No allowance for defects.
[b] Actually sawn from the trees of Yellow Poplar cut in Tennessee, United States.

YIELD.

With the average number of trees per acre and per hectare of the principal species and their average contents, the total volume per acre and per hectare, without allowance for defects, is computed in feet, board measure, and cubic meters for Tables IX and X. The minor species are not included in this estimate because of their small numbers, small size, and unimportance. Further investigation may show that some of them can be introduced into the markets, but at present they are not exploited.

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[3] See Braniff, E. A.: Grades and Amount of Lumber Sawed from Yellow Poplar, etc., *U. S. Dept. Agr., For. Ser.* (1906), Bull. 73.

TABLE IX.—*Volume per acre of the six principal species.*

[No allowance for defects. Feet B. M., Doyle rule.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.
Inches.	Centimeters.						
16	40	195	120	80	95	60	550
18	45	335	200	130	125	65	855
20	50	375	250	180	210	75	1,090
22	55	430	295	175	275	95	1,270
24	60	610	380	310	340	90	1,730
26	65	690	425	450	490	145	2,200
28	70	590	425	350	555	175	2,095
30	75	710	485	380	640	155	2,370
31	80	490	710	420	820	130	2,570
33	85	530	780	535	815	130	2,790
35	90	520	460	460	700	130	2,270
37	95	290	375	355	895	145	2,060
39	100	185	650	515	910	280	2,540
41	105	440	910	390	1,560	285	3,585
43	110	205	670	260	1,550	115	2,800
45	115	65	680	230	1,270	160	2,405
47	120	110	805	325	1,830	110	3,180
49	125	120	240	365	1,520	85	2,330
51	130	90	270	450	1,445	175	2,430
53	135	50	430	240	1,410	145	2,275
55	140		455		1,940	50	2,445
57	145	50	265	160	740		1,215
59	150		275	110	880		1,265
61	155				395		895
63	160		55	55	770	55	935
65	165						
67	170		60		240		300
Total		7,080	10,670	6,925	22,420	2,855	49,950
Percentage		14.2	21.4	13.9	44.8	5.7	100

TABLE X.—*Volume per hectare of the six principal species.*

[No allowance for defects. Measurements in cubic meters.]

Diameter above buttresses.		Apitong.	Almon.	Balacbacan.	Mangachapuy.	Lauanbagtican and Lauandunlog.	Total.
Inches.	Centimeters.						
16	40	3.60	2.21	1.51	1.80	1.10	10.22
18	45	4.93	2.94	1.92	1.83	.96	12.58
20	50	4.60	3.08	2.20	2.60	.92	13.40
22	55	4.57	3.05	1.87	2.92	1.05	13.46
24	60	5.98	3.72	3.02	4.45	.86	18.03
26	65	6.26	3.84	4.07	4.41	1.34	19.92
28	70	5.10	3.72	3.03	4.78	1.52	18.15
30	75	5.94	4.05	3.18	5.34	1.30	19.81
31	80	4	5.82	3.44	6.76	1.12	21.14
33	85	4.36	6.39	4.36	6.61	1.02	22.74
35	90	4.28	3.86	3.86	5.79	1.09	18.88
37	95	2.35	3.10	2.91	7.33	1.22	16.91
39	100	1.48	5.39	4.23	7.50	2.32	20.92
41	105	3.66	7.55	3.18	12.98	2.36	29.73
43	110	1.70	5.51	2.10	12.73	.93	22.97
45	115	.54	5.51	1.88	10.29	1.32	19.54
47	120	.86	6.40	2.56	14.56	.86	25.24
49	125	.94	1.92	2.79	11.87	.65	18.17
51	130	.70	2.09	3.42	11.21	1.35	18.77
53	135	.37	3.26	1.85	10.81	1.10	17.39
55	140		3.47		14.97	.39	18.83
57	145	.41	2.08	1.23	5.70		9.42
59	150		2.15	.87	6.87		9.89
61	155				3.17		3.17
63	160		.45	.45	6.00	.45	7.35
65	165						
67	170		.46		1.90		2.36
Total		66.68	92.02	59.93	185.18	25.23	428.99

For a safe and conservative estimate of the merchantable timber per acre, an allowance for defects should be made of about 20 per cent for Apitong, 40 per cent for Mangachapuy, and 30 per cent for Balacbacan, Almon, Lauan-bagtican, and Lauan-dunlog. This allowance is made in Tables XI and XII. Since it may be advisable to place the merchantable diameter or cutting limit at 20 inches instead of 16 inches, the merchantable stand and yield for trees above those two diameters, respectively, are given in those tables for the purpose of comparison.

TABLE XI.—*Summary of stand and merchantable yield of the six principal species 40 centimeters (16 inches) and over in diameter.*

[Allowance for defects: Apitong, 20 per cent; Mangachapuy, 40 per cent; others, 30 per cent.]

Species.	Stand.		Yield.	
	Per acre.	Per hectare.	Doyle rule, feet B. M. per acre.	Cubic meters per hectare.
Apitong	7.77	19.16	5,670	53.3
Almon	6.55	16.18	7,470	64.4
Balacbacan	4.59	11.32	4,850	42
Mangachapuy	8.45	20.85	13,460	111.1
Lauan-bagtican and Lauan-dunlog	2.07	5.11	2,000	17.7
Total	29.43	72.62	33,450	288.5

TABLE XII.—*Summary of stand and merchantable yield of the six principal species 50 centimeters (20 inches) and over in diameter.*

[Allowance for defects same as in Table XI.]

Species.	Stand.		Yield.	
	Per acre.	Per hectare.	Feet B. M. per acre.	Cubic meters per hectare.
Apitong	5.13	12.65	5,140	44.8
Almon	4.96	12.24	7,150	59.3
Balacbacan	3.52	8.69	4,640	38.6
Mangachapuy	7.31	18.02	13,240	107.5
Lauan-bagtican and Lauan-dunlog	1.41	3.48	1,880	15.7
Total	22.33	55.08	32,050	265.9

The data from which the volumes and yields are obtained is clearly insufficient to permit of an accurate estimate. This is not claimed for the above tables. They will, however, be found approximately correct and will serve as a basis for management until they can be revised. They apply to blocks 3, 4, 5, and 6, but are generally applicable to the entire area of upland forest.

This tract, having about 32,050 feet B. M. of merchantable timber (over 20 inches in diameter) per acre on 37,660 acres of forest land, therefore contains a total merchantable stock of 1,207,000,000 feet B. M., if the

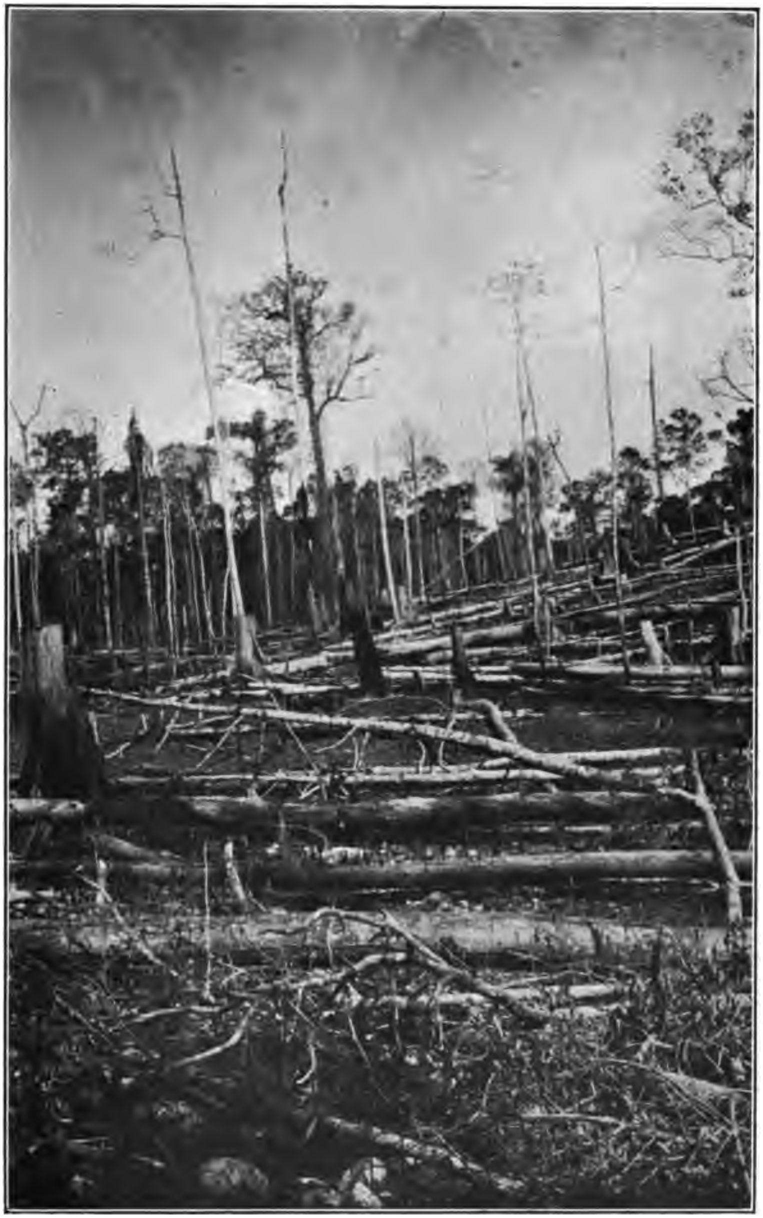

Plate III. CLEARING ON LOGGED LAND.

above yield will hold for the entire area of commercial forest, which is probable. This should be cut as rapidly as possible. It is sufficient to supply a mill cutting 100,000 feet per day for forty-two years of three hundred working days per year.

DESCRIPTION OF TREES.

PRINCIPAL SPECIES.

Apitong (*Dipterocarpus grandiflorus*).—Apitong is an important timber tree of the third group, found generally in the hill forests throughout the Islands, the timber of which comes into the market in large quantities. On this tract Apitong occurs in abundance, singly, in mixture with other species, or in small groups. It is most numerous on the slopes of the upland forest, where it is often found in almost pure groups on the tops of hills and ridges. Apitong rarely occurs above 1,800 feet elevation on Mount Silay. It prefers a deep, well-drained soil.

Apitong is a smaller tree than any of the other five principal trees, although it reaches a diameter of 145 centimeters (57 inches), with a clear length of 25 to 30 meters (80 to 100 feet). The majority of the trees, however, are small. This probably is not due altogether to natural conditions, but more to the long-continued and injurious boxing of the trees for the Balao, or pitch, which it yields.

In the forest the Apitong is a clean-looking, tall tree, with a straight cylindrical trunk, short, compact crown, and low moderate buttresses, or none at all. Apitong endures shade remarkably well, but thrives best in the stronger light on the upper slopes or tops of hills. Although seedlings are comparatively few, saplings, small poles, and large poles are present in a proportion sufficient to provide for the future of the species in the forest. Apparently it seeds well, but intermittently. No 1-year-old seedlings were observed during the field work of the past year.

Apitong is the freest from defect of the six principal species. It is sound except when it has been subjected to boxing. That the boxing is injurious and responsible for the death of many trees was proven by the observations of the various stages of decay and death of trees which, without exception, had been boxed. Notches 8 to 12 inches deep are hollowed out below to catch the pitch as it oozes out of the wood. Trees of only 40 centimeters diameter are often tapped, and large trees frequently on two sides. The balao is collected and the box is burned out every two weeks. In a short time insects and fungi take hold and the decay is rapid.

The wood of the Apitong is heavy, moderately hard, and fairly durable. It is reddish brown in color and has a straight but coarse grain. It is used in ordinary construction, in shipbuilding, and for inferior furniture. Apitong sells in Manila for ₱90 to ₱115 per 1,000 feet B. M.

Almon or *White Lauan* (*Shorea squamata*).—Almon is one of the important timber trees, the timber of which enters the market as White

Lauan.[4] -(Pl. I, frontispiece.) It occurs in mixture with other species throughout the tract, most numerous on the rich gentle slopes.

It is a very large, tall, clear tree, attaining a diameter of 170 centimeters (67 inches), a height of more than 65 meters (210 feet), and a clear length of 35 meters (115 feet). In the forest it is straighter and clearer than the other species and is characterized by less taper. A tree 135 centimeters in diameter on the stump had the following diameters outside the bark at the small end of each 5-meter log: 114, 112, 111, 103, 101, 96, and 93 centimeters, a total taper in 35 meters (115 feet) of 42 centimeters (16 inches), 21 centimeters (8 inches) of which was in the first 5-meter log.

The crown of Almon is short, sturdy, and compact. Large, high buttresses are almost invariably found on the big trees, sometimes 3 meters high and reaching from 3 to 4 meters from the base of the tree.

Almon may be classed as a fair shade endurer, although its clear, tall habit of growth shows a strong desire for light. Seedlings are not numerous in the forest, but the number of saplings and small and large poles is only exceeded by that of the Apitong.

The large trees of Almon and many of the small ones are very defective. The principal defect is a punk or rot in the heart, which varies from a small doty spot, making the heart boards useless, to large hollows extending the full length of the tree. This has probably been caused by injuries to the tops, which have permitted the entrance of destructive fungi.

The wood of Almon is light brown in color, rather soft, and not heavy. It is used mostly for interior work in the construction of houses. It is also substituted for Balacbacan for interior finishing and for furniture. Almon does not endure exposure to moisture or weather, and is very susceptible to the attacks of anay, or the white ant. It is sold in Manila for ₱70 to ₱90 per 1,000 feet B. M.

Balacbacan or *Tanguile* (*Shorea polysperma*).—Balacbacan, the timber of which is now well known in the market, occurs well distributed on the tract in mixture with the other species. It prefers deep soil on the slopes of the hills and is more numerous above 500 feet elevation. It is found on Mount Silay to an elevation of about 2,500 feet.

Balacbacan is a large timber tree not reaching the magnificent sizes of the Mangachapuy, but attaining a diameter of 160 centimeters (63 inches), a height of more than 50 meters (165 feet), and a clear length of 30 meters (100 feet). It is characterized by a stout spreading crown and a straight cylindrical trunk, with prominent buttresses at the base. It, as well as the other species of the genus Shorea in the forest, is defective at the heart. In general, however, it is less so than the others.

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[4] This wood should not be confused with that of *Shorea contorta*, the White Lauan of Mindoro, Zambales, and other provinces.

Reproduction of Balacbacan is fairly well distributed in the forest. Seedlings and saplings are not so numerous as those of Mangachapuy. The tree endures shade about as well as the Almon.

The wood of Balacbacan is porous, light in weight, and red or reddish brown in color. It is used extensively for interior finish and for furniture, and is now received with favor in Manila, where it is sold for ₱70 to ₱90 per 1,000 feet B. M. The wood closely resembles that of Mangachapuy, which has been sold in the markets under the name of Balacbacan.

Mangachapuy or *Red Lauan* (*Shorea* sp.).—Mangachapuy, known in the market as Red Lauan and Balacbacan, is both the largest and the most important timber tree on the concession. It occurs throughout the tract in mixture with other species, most numerous on the rich, moist, lower slopes and nearly level land of the upland forest.

Mangachapuy here reaches magnificent sizes. Trees 150 to 180 centimeters (60 to 70 inches) in diameter, towering to a height of more than 65 meters (215 feet), with clear lengths of 30 to 35 meters (100 to 115 feet), are not uncommon. It is characterized by stout, long, cylindrical trunk, immense buttresses, and sturdy spreading top.

The Mangachapuy endures shade well. Seedlings, saplings, and small and large poles are abundant. (Pl. II.) It is evident from the abundance of small seedlings that a heavy seeding of this species occurred one or two years ago.

The Mangachapuy is the most defective of the principal species. The large trees are all subject more or less to dote, or rot, at the heart, and it is difficult to find a small specimen which is not already slightly affected.

The wood of Mangachapuy is sold in the markets as Balacbacan or Red Lauan. It is porous, red in color, and light in weight. Locally it is used in the construction of houses and bancas, or dugouts. It is now being used extensively for interior finish and furniture. It is sold in Manila for ₱70 to ₱90 per 1,000 feet B. M.

Lauan-dunlog (*Shorea contorta*) and *Lauan-bagtican* (*Shorea* sp.).—These two trees are relatively few on the tract. Lauan-dunlog is the White Lauan of commerce. Both occur in mixture, preferring the moist, steep slopes in the upland forest, near streams, and are also scattered in the river-valley forests. The close resemblance between the two species and the difficulty of distinguishing them in the woods makes it advisable to treat them as one. Both are large trees, attaining a diameter of 150 centimeters (60 inches). They resemble in general form the Almon already described, and are subject to heart rot and other diseases to about the same degree as Almon. In proportion to their numbers in the forest, reproduction is satisfactory. Their wood has, in general, the same characteristics and uses as Almon, but is a trifle harder and heavier. They are sold in the markets as White Lauan.

MINOR TREE SPECIES.

The many minor tree species scattered over the tract in small numbers and sizes are of little or no importance commercially. The following list includes the larger and the more numerous: *Diospyros* sp. (Ata-ata), *Vitex aherniana* (Dungula), *Hopea philippinensis* (Guisoc-guisoc), *Canarium* spp. (Moabog), *Eugenia* spp. (Bulog), *Kurrimia luzonica* Vid., and *Livistona* sp. (Palma brava). These trees are so well distributed through the forest that large numbers of no one species can be found within a prescribed area. There are but 2.55 trees per acre 40 centimeters and over in diameter. They are all small, dominated trees, growing in the shade of the large Dipterocarps. Although many of them doubtless possess value for some purposes, only three (Dungula, Ata-ata, and Palma brava) can have any importance at present to lumbermen.

Dungula,[5] which belongs to the same genus as Molave, is a small tree, seldom exceeding 60 centimeters (24 inches) in diameter, and occurs well distributed throughout the forest, but is most numerous on moist, gentle slopes and near streams. It is a small, rather crooked, ill-formed tree, growing in the shade of the dominant Dipterocarps. It is a true shade endurer and reproduces well.

The wood of Dungula is very hard and heavy, resembling Molave so closely that it is often substituted for that species in the Manila market. It is extremely durable in the ground. Fallen Dungula trees in the forest, after the narrow sapwood has rotted off, remain hard and sound, although it is evident that they have laid on the ground for a long time. Dungula is gladly used by the inhabitants of northern Negros for harigues, or house posts. It has not, however, because of its relative scarcity and small size, which makes logging costly, been introduced into the timber market on any scale. There is no doubt that it is a very satisfactory timber for small house posts, railroad ties, and mining timbers, especially for the latter.

Ata-ata is a small tree belonging to the same family as the valuable Ebony and Camagon. It resembles very closely Bolongeta (*Diospyros pilosanthera* Blanco). Ata-ata seldom forms more than 1 to 2 inches of the black heartwood which makes species of the ebony family valuable for cabinetwork. For construction purposes it is hard and strong. Ata-ata occurs throughout the forest in the lower dominated story. It is more numerous on the lower gentle slopes. It is a straight, well-formed tree, often slightly rectangular in cross section at the base. Its deep blue-black bark gives it a striking appearance in the forest. It reproduces well and endures heavy shade.

The following table shows the sizes and number of trees per acre and hectare of Dungula and Ata-ata:

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[5] This tree is known in Manila markets as Sasalit, the common name for it in Zambales. In portions of Tayabas it is called Igang.

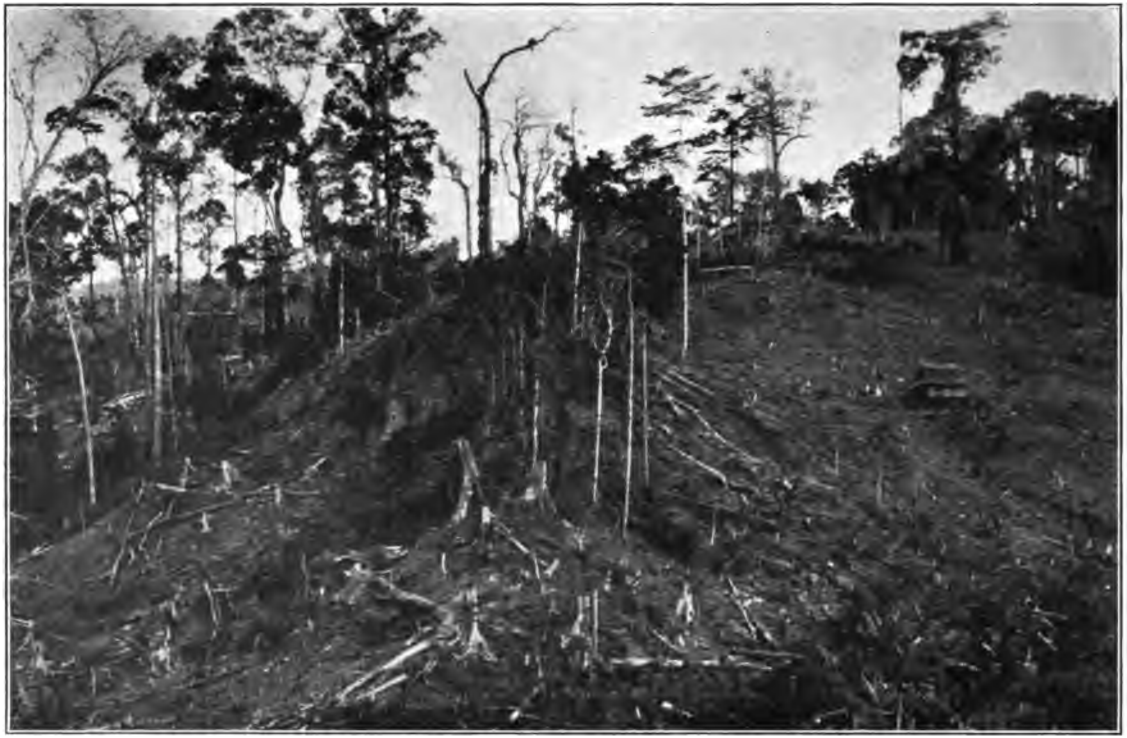

PLATE IV. CHARACTERISTIC CAIÑGINS UNDER RUDE CULTIVATION.

TABLE XIII.—*Stand of Dungula and Ata-ata.*

[Average of 185 acres in blocks 3, 4, 5, and 6.]

Diameter above buttresses.		Number of trees per acre.		Number of trees per hectare.	
Inches.	Centimeters.	Dungula.	Ata-ata.	Dungula.	Ata-ata.
12	30	0.511	0.407	1.262	1.005
14	35	.385	.644	.950	1.590
16	40	.082	.289	.203	.714
18	45	.155	.178	.383	.439
20	50	.082	.059	.202	.146
22	55	.022	.029	.054	.072
24	60	.022	.0078	.054	.018
26	65	.0073	----------	.018	----------
28	70	----------	----------	----------	----------
30	75	.0073	----------	.018	----------
31	80	.0073	----------	.018	----------
33	85	----------	.0078	----------	.018
35	90	----------	----------	----------	----------
37	95	----------	----------	----------	----------
Total 40 centimeters and over		.3849	.5696	.950	1.407
Total 30 centimeters and over		1.2809	1.6206	3.162	4.002

Palma brava, or Anahao, is a very useful tree locally, although it reaches no large size. Its poles are used in house construction, usually split for flooring. Its large leaves are used extensively for thatching. It occurs generally on the moist slopes, but the better trees have been badly thinned out in the lower edge of the tract. Farther back it occurs in considerable amounts as a very tall, clear tree, up to 30 centimeters in diameter.

The minor species will be generally used in railroad and skid-road construction. Dungula, however, should be exploited and introduced into the market. As fast as investigation shows that any other of the minor species possesses a commercial value, it should be exploited by the company.

INJURIES TO WHICH THE FOREST IS LIABLE.

The forest is subject to damage from natural and artificial causes. To the former belongs the damage caused by insects, fungi, and winds; to the latter the damage caused by logging, fires, and caiñgins. The latter are by far the most important.

DAMAGE FROM NATURAL CAUSES.

The amount and importance of the insect damage are not yet known. There is a beetle (*Crossotarsus* sp.) which bores into the log soon after the trees are felled, making it inadvisable to cut the trees more than a few days ahead of the skidding. The injury is greatest during the wet months of March and April. Since it is impossible to remove all the bark from the logs in the woods, peeling them immediately after cutting is ineffectual. It will always be necessary to remove the logs from the woods within a week after felling. The damage done by this insect appears in the lumber as small black pin holes.

Fungi, though useful in cleaning the forest, inflict great injury. The prevalent heart rot in the various species of Shorea is due to a number of fungi not yet determined. Apparently the spores of fungi enter through some injury in the tops of the trees. The disease then rapidly works down through the soft heart. Year by year the work continues, until the tree is only a hollow shell. All large trees of the genus *Shorea* are affected in this way to a certain extent. The only remedy now possible is to cut the diseased trees as soon as possible, thus removing the centers of infection and lessening the loss of timber. Since the entire tract is covered by mature timber almost equally damaged by this disease, the entire area should be logged off as soon as possible.

The damage from windfall is here negligible. The only trees observed blown down by the winds were overmature and diseased. Wind thus merely assists the ants, anay, and fungi in removing the dead trees from the forest.

DAMAGE FROM ARTIFICIAL CAUSES.

Forest fires in the untouched timber are impossible, because of the evergreen, moist character of the forest, and the lack of dry undergrowth and litter. In the cutting area after logging, however, there is considerable danger during the dry months of March and April, when the great quantity of tops and other débris is well dried out, that a fire will sweep through, destroying the reproduction and killing many of the remaining trees. Yet, even in the cuttings a fire must be set at the opportune time, with a favoring wind, in order to spread over any large area. A moderate degree of watchfulness will prevent accidental fires in the slash.

The principal and important injury to the forest is caused by caiñgins, or clearings. (Pls. III and IV.) Caiñgins are a system of shifting agriculture. They are small clearings, rarely exceeding 25 acres in area, made in timber or brush land by ignorant, irresponsible persons. The undergrowth, small trees, and some of the large trees are cut during the months of January, February, and March. In April, just before the spring rains, the dried mass is fired. If the weather has been favorable, the fire burns eagerly and leaves only charred trunks and stumps to hinder planting. Crops of corn, camotes, and sometimes tobacco are carelessly cultivated for one, two, or three years, until grass and other weeds make cultivation difficult. Then the author of the caiñgin abandons it to find another spot in the forest in which to repeat the operation.

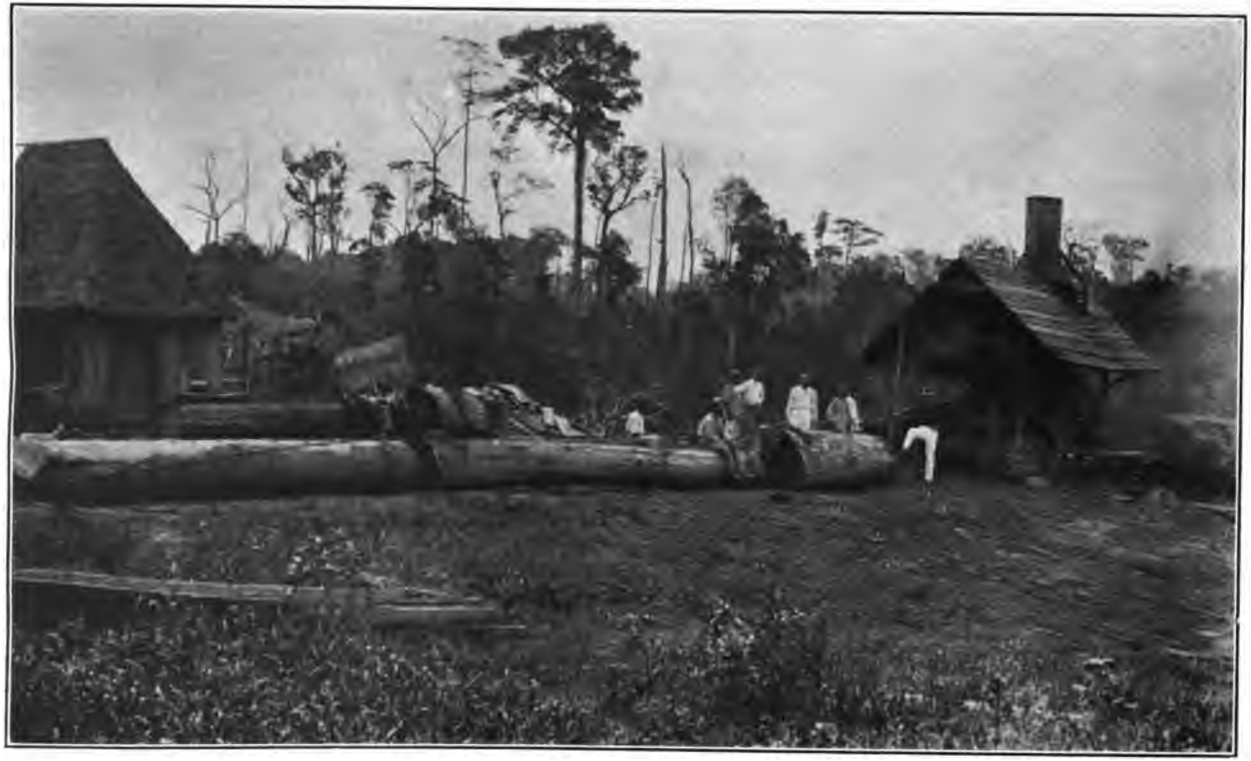

Plate V. HAULING ENGINE AT THE LANDING.

The problem of protecting the tract against this danger is made more difficult by the attitude of the owners of several sugar plantations adjacent to the northern boundary, who evidently encourage and inspire many of the clearings in the public forest, with the object of securing the land after it is abandoned by the authors of the caiñgins. Recently they have attempted to secure the land through homesteads made by persons dependent upon them. Where such applications have been made for land which is suitable for agriculture, and on which there is little or no merchantable timber, it has been certified as more valuable for agricultural than for forest purposes. In many cases, however, applicants for heavily timbered land have made clearings immediately after, if not before, making their applications and before receiving the approval or disapproval of their applications. In this way, much valuable and accessible timber within the tract granted the Insular Lumber Company has been destroyed. From this a difficult problem has arisen in regard to the land suitable for agriculture. On such lands covered with timber which will be exploited by the Insular Lumber Company, it is evident that homesteads should not be allowed until the timber has been removed, or should only be granted under the condition that no clearings be made until the land has been logged by that company. But if the applicants have entered the forest and made clearings on the land prior to its examination by the forest officer, there is then no reason why the homesteads should not be approved. The forest officer can, however, have the applicants punished for making the caiñgins without permission, but this will not affect the final disposition of the land nor compensate for the timber destroyed. This problem was met during the past year in heavily timbered land in block 7, adjoining a neighboring plantation.

The punishment of men making caiñgins without permission in the public forests, as provided in article 25 of the Forest Law, will not alone serve to remedy the evil. Imprisonment has no great terror for the offenders, and they are seldom able to pay the fines imposed. During the fiscal year 1905 about 300 acres of caiñgins were made in heavily timbered forest along the northern boundary of the tract, which destroyed about 7,000,000 feet B. M. of merchantable timber. Ten offenders were arrested and punished with from five to thirty-five days' imprisonment each, but no fines could be collected for the timber destroyed. On their release from prison they returned to their clearings which they are now cultivating. It is absolutely necessary to protect this tract against caiñgins in order to initiate even the simplest plan of forest management and regulation. Prevention is the only means. This can be done by—

First. Marking and posting warning notices along the northern boundary line.

Second. Patrolling the forest where there is danger of caiñgins.

Third. Marking the boundaries of existing clearings within the tract to prevent their extension by means of caiñgins.

Fourth. Permitting caiñgins on the partially timbered land outside of the tract.

Injuries from logging are unavoidable. Small trees will be crushed in felling large ones, and seedlings will be destroyed. It is necessary, however, that care be taken to make this injury as small as possible. Damage from logging will be treated more fully under a succeeding heading.

THE UTILIZATION OF THE FOREST.

TIMBER.

HISTORY OF LUMBERING.

Lumbering in northern Negros previous to 1903 was carried on in a desultory manner by the Spanish and Filipino licensees. They hauled the timber to the nearest streams by carabao, where the logs were made into rafts and towed to the Iloilo market, about 70 miles distant. It is reported that fine Molave and Narra were obtained in Spanish times along the coast in Cadiz and Sagay. The forest of third and fourth group trees, which covered most of the area, was gradually pushed back to its present position. The timber of this forest has always been in disfavor with the Spaniards and Filipinos, and doubtless very little of it in the destroyed forest of this type was utilized.

Lumbering on the tract itself has a brief history. Previous to 1903 practically no timber had been exploited, except for local needs, although clearings had made inroads along the northern side. In 1903 a license to cut 100,000 cubic feet of timber in the sitio of Sanghai, on both sides of the Himugaan River, was granted to the Iloilo Electric Company. This company installed the present small circular-saw mill, having a capacity of about 15,000 feet B. M. per day, and a logging outfit of one donkey engine, wire cable, etc.

This preliminary and experimental operation, though not a financial success at the time, owing to the difficulty of introducing species against which the markets were prejudiced, and to floods which caused considerable damage to the mill and carried off many logs, nevertheless demonstrated to the satisfaction of the promoters that a large and modern plant, operated on American principles, would pay, and that steam logging was the best method to use in exploiting the large timber of this forest.

In 1904 the Insular Lumber Company, incorporated under the laws of the State of New York, took over the plant of the Iloilo Electric Company and secured the present concession under a license agreement, to exploit the timber on the tract for a period of twenty years. In return,

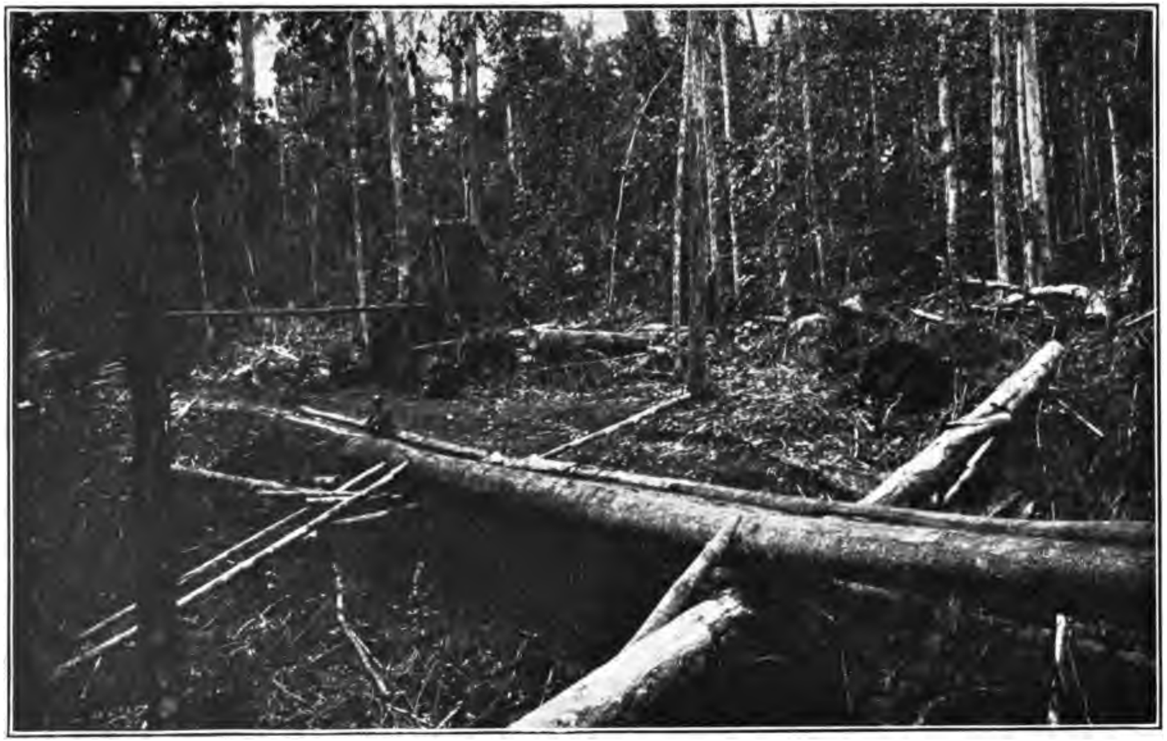

PLATE VI. BRIDGE ON THE HAULING ROAD. (NOTE DENSITY OF THE GROWTH REMAINING ON LOGGED LAND.)

it bound itself to comply with certain cutting rules and other regulations. It was its intention to install at once a new mill, of 100,000 or 200,000 feet capacity per day, but various difficulties prevented its accomplishment until the present year. The new mill is now being installed and will be completed in the near future.

The Iloilo Electric Company and the Insular Lumber Company have logged off about 250 acres from July 1, 1903, to July 1, 1906, most of which was cut over by the latter company. In 1903–4 the former company manifested about 300,000 feet B. M., for which they paid about $1.33, gold, per 1,000 feet B. M. The Insular Lumber Company has manifested in the first two years of its existence about 1,770,000 feet B. M., for which it paid about $1.06, gold, per 1,000 feet B. M. This amount manifested does not include a large amount of lumber used in the construction of the plant and on which no Government charge has been imposed.

The discrepancy between the large area cut over and the relatively small amount of timber manifested is accounted for by the unusual waste in logging, by the small size of the mill, which could not handle the largest trees, by leaving the White Lauans standing over a large part of the area because it was not marketable, and by the fact that the company had the free use of timber for construction purposes on the tract during the past two years.

PRESENT LUMBERING OPERATIONS.

General conditions.—Differences in climate, transportation, and labor, as well as in the timber, make successful lumbering in the Philippines more difficult than in the United States. The Insular Lumber Company, under able management, has been meeting these difficulties and has gradually overcome them.

A lumberman in the Philippines has to choose between locating his mill near the forest or in one of the large towns or markets. The larger mills are found in Manila. The five largest mills in the Islands are in Manila and have a total daily capacity of 100,000 feet B. M., although the actual amount cut is less than half the capacity. Transportation of logs and lumber is entirely by water, and for long distances logs or lumber are not rafted. Mills which purchase their logs in the market are better located in the cities. The Insular Lumber Company, however, having an almost unlimited supply of available timber and the necessary means to log it, and having a deep, navigable river penetrating almost to its timber, rightly decided to place its mill on this river as close as possible to the forest and to ship the sawn lumber to Manila and the other markets.

The great size and weight of the timber on the tract made it necessary to employ some other system in logging than the ordinary native method.

Carabaos are scarce and expensive, and, in addition, are unable to haul the largest logs. Steam skidding and hauling seemed the only method available. The forest is one easily logged. The configuration of the ground is favorable to steam skidding and railroad transportation. Roads can be built with much less grading and bridging than in the forests of western Washington. The hot climate is not a hindrance in the mill or woods, and during the rainy season logs are more easily skidded.

A sufficient supply of good native labor is essential for a large lumbering operation, like that of the Insular Lumber Company. Fortunately, it has located in a populous region, where there is a laboring population employed on large sugar estates. Consequently the company has not encountered great difficulty in securing a force of about 80 Filipino workmen. The efficiency of the labor, judged by American standards, is low, but compared with similar labor in other parts of the Islands, stands high. The men work fairly steadily, are docile, and easily taught. Among them the company now has some who do very good work in the woods and in the sawmill. They are treated well, furnished with good frame houses without rent, and are paid about ₱0.50 per day. Those who become skilled in special work receive slightly higher wages. As the ordinary wage paid on the sugar estates is ₱1 to ₱1.50 per week, with food, the company has little difficulty in securing and keeping its native labor. It is a more difficult problem to obtain and keep skilled American labor, which has to be secured from the United States. Only high salaries will bring suitable American sawyers or loggers to this country, and even then they will not make long-time contracts.

Logging.—This company and the Iloilo Electric Company have logged about 250 acres of forest land since August, 1903. The logging camp still stands at the place where cutting was first begun on the bank of the Himugaan River, less than 1 mile from the sawmill. The logs are hauled to this point and rolled over the steep bank to the river. A group of houses for the employees, a machine shop, and the hauling donkey engine are also located at this place. From the landing a hauling road extends 1 mile west into the forest, where the cutting is now going on.

The method used in logging is an exact copy of the steam logging system used in western Washington. (Pls. V, VI, VII, and VIII.) The outfit consists of one large hauling donkey, of about 50 horsepower, about 1 mile of 1-inch hauling cable, about 1 mile of three-fourths-inch haul-back cable, one skidding or yarding donkey of about 40 horsepower, over 2,000 feet of three-fourths-inch yarding cable, and the necessary blocks, hooks, rollers, chokers, cant hooks, axes, saws, etc.

The rollway or landing is the almost perpendicular river bank, here nearly 100 feet high, much higher than is necessary or desirable. From

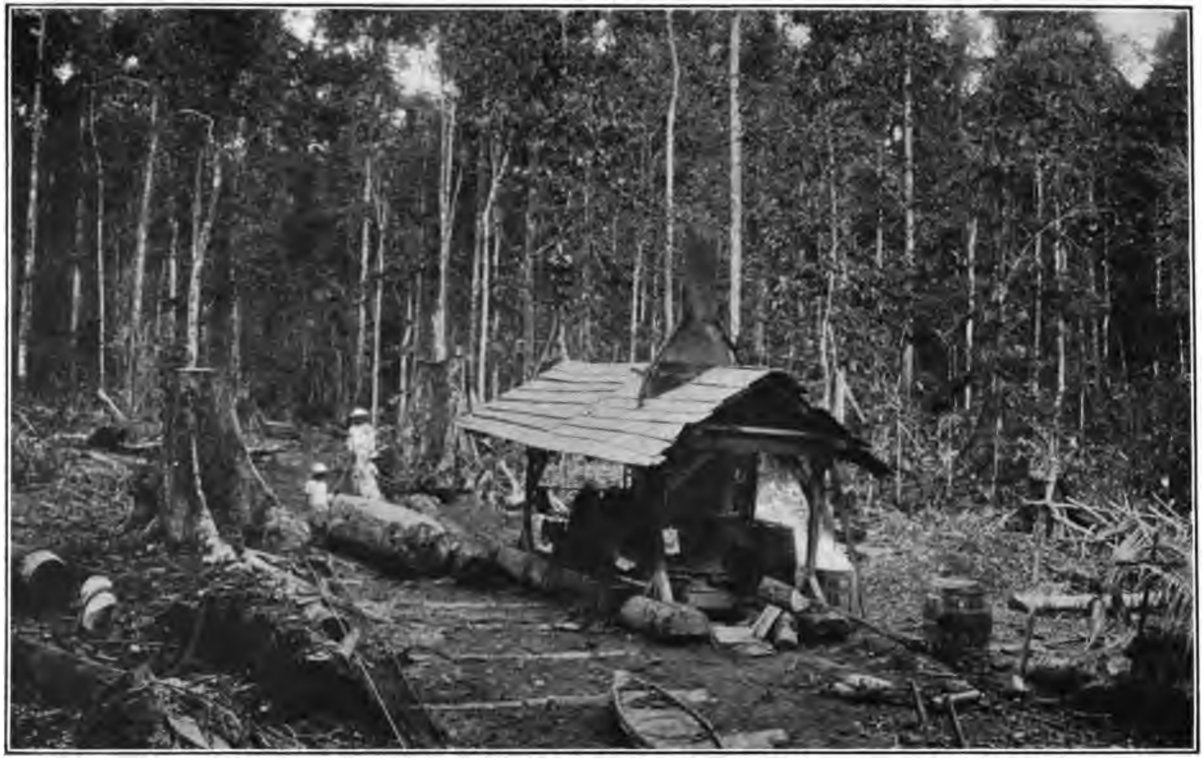

Plate VII. YARDING ENGINE AT THE END OF THE HAULING ROAD.

the hauling donkey stationed at the top (Pl. V) a nearly straight road, about 10 feet wide, has been made into the forest. This is carefully graded and has strong bridges over the few arroyos, or gulleys. (Pl. VI.) Across the road, and about 6 feet apart and buried about one-half in the earth, are placed skids or sleepers, 8 feet long and 14 to 20 inches in diameter, notched at the middle to about the level of the ground. The timber is hauled over these skids. From this main road radiate short skid roads or trails not more than 1,000 feet long. These are simple dirt roads, without grading. The hauling cable from a drum on the engine at the rollway runs on the ground along the hauling road and over iron rollers, where a turn in the road makes this necessary. At the end of the road, where the yarding donkey is set up (Pl. VII), the hauling cable passes through a block and returns as the haul-back cable to another drum on the engine. The yarding cable runs from the yarding engine in a similar manner into the forest over a skid road, through a block and back again. Parallel to these cables are wires connected with the whistles on the engines, by which signals are given to the engineers.

The trees are felled with axe and saw by fellers working in pairs. A staging is built of small poles to enable them to get above the large buttresses. (Pl. I.) A tree is notched on one side, sawed on the other, and wedged over, if necessary, until it falls. One felling crew of two men cuts three or four large trees per day. Other men then cut up the tree into logs 16 and 32 feet long, and occasionally 12, 18, 20, and 24 feet long. (P. VIII.) The logs are then nosed at one end, and if very large are barked on one side to make hauling easier. The skidding crew place a choker (noose of cable) around the log and fasten it to the end of the skidding cable, signal the skidding engine, and the log is pulled out and hauled to the main road. When several logs (usually two when the skids are dry, and four or more when they are wet) lie on the main road, they are coupled together by hooks or grabs driven into their ends and connected by cable. The head log is fastened to the hauling cable, the signal is given, and the train of logs, or turn, as it is called, moves down the road to the rollway, where the logs are rolled into the river and confined within a boom until they are floated to the mill. As soon as the logs are hauled in, the engine reverses and the haul-back line pulls the hauling cable back into the woods.

The method will be changed when the new logging railroad is completed. The engines will then haul directly to the railroad track, where the logs will be loaded on cars and taken to the mill. At present the logs are floated down the river to the mill at high tide. With the exception of Apitong, they all float well, but the danger from floods and lack of water in the dry season, as well as the constantly increasing distance of the forest from the river, make this method of transportation less satisfactory than a logging railroad, which can be built at a moderate cost.

The men employed in logging and their wages are as follows:

Americans (2):		
1 logging superintendent	per year....	₱4,200.00
1 assistant	per day....	4.00
Filipinos (42):		
1 foreman	per day each....	1.50
1 engineer	do........	3.00
1 engineer	do........	1.50
2 firemen	do........	.50
1 subforeman	do........	.60
4 fellers	do........	.65
6 buckers	do........	.50
7 cable men	do........	.50
1 sled tender	do........	.50
4 woodcutters for the engines	do........	.50
4 road builders	do........	.50
10 water carriers for the engines	do........	.50

(₱2=$1, United States currency.)

This amounts to a daily labor cost of about ₱45. The logging crew handles on an average from 5,000 to 10,000 board feet of logs per day.

The above method, which has been employed since the commencement of the operations, is being supplemented by a railroad which is now being installed. The road is equipped with two locomotives and twelve logging trucks or cars. The gauge is 3½ feet. The donkey engines and cable system will continue to be used but will haul the logs to the railroad track instead of to the river bank. This will give a great increase in the daily output of logs.

Waste and injury to the forest.—The area thus far logged has been cut over without much restriction or regulation. About one-half of it has been burned over and is now partly under sugar cane. The remainder is slash as it has been left by the company. Since it is agricultural land, to a large extent homesteaded, it will not be managed for a second timber crop.

The trees cut have been almost entirely the six principal species, with an occasional large specimen of some other kind. Few trees less than 50 centimeters (20 inches) in diameter have been cut and many larger ones have not been removed. The largest trees have been left because the mill could not handle them. On part of the area the Almon and White Lauans were not cut, because at the time there was no demand for that kind of lumber. The following table shows the number of saplings, poles, and trees remaining on one-half hectare of cut-over land. Many small trees are lacking which were destroyed but not utilized during the logging:

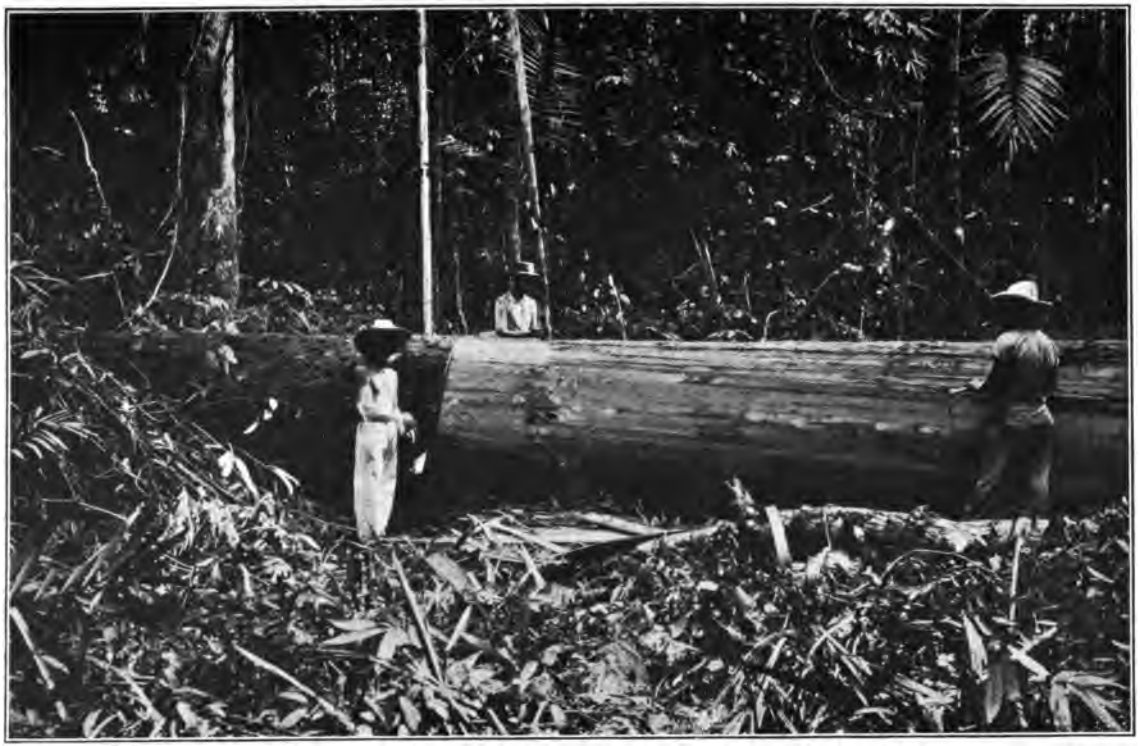

PLATE VIII. CUTTING UP A LARGE MANGACHAPUY TREE.

TABLE XIV.—*Saplings and trees remaining on one-half hectare (1.23 acres) of cut-over land.*

Size.	Apitong.	Almon.	Mangachapuy.	Balacbacan.	Dungula.	Ata-ata.	Guisocguisoc.	Other trees and shrubs.	Total.
Sapling	30	8	5	4	14	13	8	84	166
Small pole	5		4		8	1	2	8	28
Large pole	3				3	3	1	3	13
30 centimeters	1					1		1	3
35 centimeters	1								1
40 centimeters	1	1	2						4
45 centimeters			2						2
50 centimeters	2		1						3
55 centimeters			2					1	3
60 centimeters		1							1
115 centimeters			1						1
130 centimeters			1						1
Total	43	10	18	4	25	18	11	97	226

The logging makes a bad slashing. The tops and rotten logs of the large trees piled on the small trees crushed by their fall form a dense and almost hopeless mass of débris. Some of this is unavoidable, but care in felling the large trees and the utilization of as much of the timber as is possible will reduce the damage. Plates IX and X show pieces of good and bad slash. Fire in the cuttings during the dry months of March and April would be destructive to the young growth. Fire, however, does not run readily until the brush is thoroughly dry and the wind favorable. This condition obtains only for a few days in March and April. Sometimes the friction of moving logs upon the skids causes fires which might spread to the cuttings.

There is considerable waste in the felling and cutting up of trees. The Filipino fellers are usually not trustworthy and must be watched. Occasionally they leave stumps much higher than is necessary. High stumps can not be entirely avoided, because of the difficulty in sawing swell-butted logs in the present mill. With a new band-saw mill capable of handling logs of any size, the stump height should be reduced. The average stump height of 23 Mangachapuy trees felled during the past year is 9 feet (2.8 meters) and of 13 Apitong trees 4.2 feet (1.3 meters). Apitong is much less buttressed than Mangachapuy and is a smaller tree. It is unreasonable at present to require that the large buttresses be chopped through in felling the trees, but it is practicable to cut at the point where the principal buttresses end. In cutting the trees into logs, it is difficult to determine when defective ones will repay handling. In cases of doubt, the tendency is to leave them in the woods. Defective top logs are much more doubtful that butt logs, being knotty and diseased around the knots, which injures nearly all boards in the logs. However, when the company has gone to the expense of building a logging railroad and setting up donkey engines and cable, it is to their interest to remove every possible stick of timber from the area. Clear logs, not more than 50 per cent defective, should repay the cost of handling. They would also assist in bearing the expense of building roads.

Little sound saw material which is not excessively knotty is left in the tops. As a general rule, the trunks of fairly sound trees are utilized up to the large limbs. More than this is impracticable at present, as there is little sale for knotty lumber. Much of this material in the tops would make boxes. It may be found profitable for the company to manufacture box boards, in which case much timber now wasted could be utilized.

Another source of waste is the fuel used by the engines. This is usually secured from defective logs, which are hauled in and cut up into firewood. The tendency is to use logs which would be more valuable for lumber. Care should be taken to use no logs for this purpose which contain 50 per cent or more of good material.

A large number of trees are necessarily used for the construction of roads and bridges. One mile of hauling road requires over 100,000 feet B. M. for skids alone. Large amounts in the future will be necessary for ties, bridge timbers, etc. At present, Apitong, Ata-ata, and small trees of the principal species are used. Unmarketable trees and tops of felled trees, as far as possible, should be used for construction work, except on land which is to be cleared for agriculture, where small trees of all kinds can be used.

Logging does injury to the small trees and reproduction, which are to be the basis of the future forest. The large and overmature trees should be cut out to give the young growth an opportunity to take their places. Consequently, the logging must not destroy more than is necessary of the small growth. Much of this damage is unavoidable. The fellers, however, can be shown how to drop the trees where the damage will be least.

The sawmill.—The present sawmill is located on the right bank of the Himugaan River, about 6 miles from its mouth and about 1 mile north of the logging operation, which is on the opposite side of the river. The location is at the head of navigation for small steamers, although high tide reaches nearly 2 miles farther up. The mill stands on the river bank, jutting slightly over the water. (Pls. XI and XII.) From the mill a short tramroad runs to the lumber yard, directly in front of which is the dock. (Pl. XI.) Surrounding the yards are the office and quarters of the employees. The mill is operated by a steam engine and is equipped with a circular saw, a top saw, a simple edger and trimmer, and a saw-filing machine.

The logs are boomed just below the mill in the river and are brought up into the mill by a bull wheel and cable. They are then rolled on to the carriage by a chain and drum operated by the engine. The carriage is run by friction feed. The logs are sawn slowly and carefully. The sawn lumber passes to the edger on dead rollers, is lifted by men to the trimmers and from there to the truck, which bears it to the yard. The principal species cut present no great difficulties in sawing. Apitong is much harder on the saws than the others. The waste is large, owing not only to the defective character of the timber but also to the inadequacy of the mill and the unskilled labor at the edger and trimmer. The standard length of logs is 16 feet, but some 12, 14, and 18 foot logs are cut. The lumber is cut mostly in 1 and 2 inch thicknesses, with some 2 by 4's and special sizes. It is piled in the yard without cover other than a few boards, and without grading except by species and thickness. Most of it is shipped green to Manila, as the demand is greater than the supply. It is all clear lumber, and with careful grading and seasoning its quality would be much improved. The mill has been subject to some shut downs, owing to floods, breakage, and lack of logs. The following is the average operating pay roll at the sawmill:

Americans (3):		
1 sawyer	per year	₱4,000.00
1 bookkeeper	per month	150.00
1 setter	per day	4.00
Filipinos (28):		
1 dogger	per day each	1.00
1 dogger	do	.65
1 engineer	do	2.00
1 fireman	do	.60
1 fireman's helper	do	.50
1 offbearer	do	.50
1 offbearer's helper	do	.50
2 men sawing logs in the water	do	.50
2 men hauling logs into mill	do	.50
2 edgers	do	.75
2 trimmers	do	.50
2 men loading trucks	do	.50
1 man removing sawdust	do	.50
8 yard men	do	.50
2 watchmen	per month each	15.00

₱2=$1, United States currency.

This is a daily labor cost of about ₱42.

Cost of lumbering.—The estimated cost of logging and manufacturing lumber on this tract is only approximate and is intended as an indication of what can reasonably be expected under fair management.

The following is the cost per 1,000 feet B. M. of the lumber delivered in Manila, including deterioration, repairs, and interest on the investment at 10 per cent:

Cutting and hauling logs to the river	₱7.00
Floating logs to the mill	.30
Sawing and piling in the yards	6.00
Loading on barges at the dock	.40
Freight to Manila (about 400 miles)	10.00
Lighterage in Manila	2.00
Salaries of higher officials	9.00
Average Government charge, or stumpage	2.50
Total	37.20

It is certain that with a thoroughly modern mill and a logging railroad, which the company is now putting in, the cost per 1,000 feet will be reduced much below the above figure. Perhaps the pay rolls given above and the freight and Government stumpage charge will indicate better to lumbermen what the cost should be.

Markets and transportation.—The markets for the lumber are the cities of Manila, Cebu, and Iloilo. The distance by water to Manila is about 400 statute miles, to Cebu about 140 miles, and to Iloilo about 70 miles. Very little lumber can be sold locally or outside of those towns. Manila is the chief market. In the past two years the company has sold about 1,300,000 feet B. M. of timber in Manila, 190,000 feet B. M. in Cebu, and 275,000 feet B. M. in Iloilo. About 7,300 feet B. M. only were sold to local consumers. At the beginning there was difficulty in selling large shipments of lumber because of the prejudice against Lauan. The demand has slowly increased until now what is known as Red Lauan is taken in large quantities, and the White Lauan finds a fair sale. Its principal competitor is Oregon Pine, which is about equally good for most purposes, and sells in Manila for about ₱75 per 1,000 feet B. M. The Insular Lumber Company should be able to manufacture their lumber and deliver it in Manila at a price which would gradually drive out the Oregon Pine. Manila would at the present time use 100,000 feet B. M. per day if it were available. It is possible that some of the clearest and best Balacbacan and Red Lauan can be exported, possibly to the United States. A small lot was shipped to New York, where it was received with favor.

Transportation of lumber is by water. Freight to Manila in barges (Pl. XI) towed by a small steamer is ₱10 per 1,000 feet B. M. To Iloilo and Cebu in lorchas the freight rate is about the same.

Prices and Government charges.—In the Philippine Islands the Government charges for timber are usually levied on round logs. For timber cut in the province of Negros Occidental they are ₱2.50 per cubic meter for first-group timber, ₱1.50 for second group, ₱1 for third group, and ₱0.50 for fourth group, which is equivalent to about ₱10, ₱6, ₱4, and ₱2, respectively, per 1,000 feet B. M. In the license agreement with the Insular Lumber Company, however, provision is made that the charges be paid on the sawn lumber, plus 15 per cent for loss in sawing. Since the loss in sawing is more than 15 per cent, the company has profited by the arrangement, as is shown by the following figures of cost per 1,000 feet B. M. of the sawn lumber. The timber cut by the Insular Lumber Company is almost exclusively of the third and fourth group. In the fiscal year 1904–5 they paid an average price of ₱0.64 per cubic meter, or ₱1.76 per 1,000 feet B. M., and in 1905–6 ₱0.87 per cubic meter, or ₱2.37 per 1,000 feet B. M. As the company receives on an

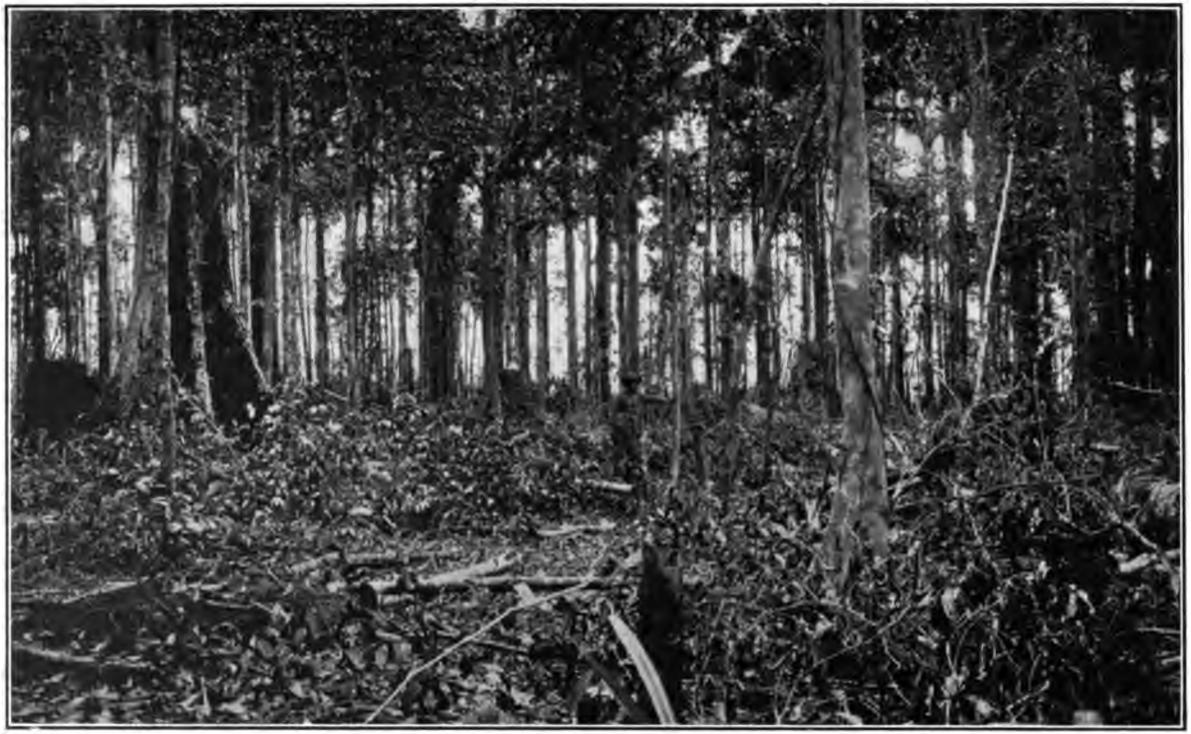

PLATE IX. FOREST IN GOOD CONDITION AFTER LOGGING.

average of more than ₱60 per 1,000 feet B. M. for their lumber in Manila, the above stumpage charges are low.

Prospects.—It is apparent from the above that a modern lumber enterprise on this tract ought to be successful. Believing this, the Insular Lumber Company is now increasing its equipment and making improvements. A new modern double mill is being built, which will have a capacity of 100,000 feet B. M. per day. It will be equipped with a 9-foot wheel and 13-inch band saws. The logging railroad is already completed from the mill to the timber and will soon be in operation. The company is ready to install a tie-impregnating plant just as soon as it can make contracts with the new railroads to take the output. Profiting by the experience of the past two years, the company will put capable men in charge and will use every effort to make the operation as efficient as any similar one in the United States. Rightly conducted, the enterprise should pay a handsome profit, at the same time furnishing lumber to the people of the Islands at prices lower than that of Oregon Pine. The railroad which will soon be built, with Government aid, in Negros Occidental from Escalante to Binalbagan or Ilog will pass close to this tract, if it does not go through its lower side. The new railroad will naturally benefit the Insular Lumber Company by furnishing a market for railroad ties and construction timber and by making available the local markets of the Province of Negros Occidental.

MINOR FOREST PRODUCTS.

Various minor forest products are collected on the tract by the inhabitants of this region. Chief of these is bejuco (rattan), which occurs throughout the concession. It is now rather scarce near the edge of the forest and in the more accessible parts of the tract, owing to the long-continued custom of collecting this product. To obtain good bejuco, it is now necessary to go 5 to 10 miles into the forest, although small specimens are abundant everywhere. The demand for the bejuco is strong in the sugar haciendas and towns of Negros, where its principal use is for tying up sacks of sugar. The prices are such as repay the collector, who usually builds a house in a good situation in the forest, and with the help of a few natives, Visayans or Negritos, collects the bejucos, putting them up in small bundles of 100 pieces, ten of which form large bundles, which are then carried out by men or carabaos. Three such camps were found on the tract. In addition, many persons enter the tract for a day or two to take bejuco for their personal use. The best bejucos on the tract are Gatasan, Yaming, Lontoc, and Calape. Split bejucos, used in tying up sacks of sugar, are worth ₱1.50 per 1,000; entire bejucos, 8 meters long, used in binding rafts, ₱15 per 100. Long bejucos for special purposes bring high prices.

Balao, the pitch obtained from the Apitong tree by a destructive system of boxing, heretofore described, has for some years been collected on the tract. It is a dirty-gray pitch, used locally to make torches and commercially to calk boats. Its value in Cadiz is from ₱0.50 to ₱0.75 per 5-gallon can. It is doubtful if one tree yields more than one such can per year under the present method of collecting. The product does not compensate for the damage done to the tree. Until a less injurious method of tapping the Apitong is devised, the collection of balao on the tract should be prohibited.

Two vines, Jagnaya and Sigid, which are collected to a limited extent, occur on the tract. They are small, about 1 centimeter in diameter, long, and very strong. They are used almost exclusively in the construction of fish corrals and are worth in Cadiz from ₱0.60 to ₱0.70 per 1,000.

The firewood possibilities of the concession at present are small. Neighboring sugar haciendas use considerable wood for fuel, but prefer to get it from the mangrove swamps, or if from the mountain forest to cut it themselves. Neither is it probable that firewood cut on the tract can be shipped to the large towns of the Islands in competition with the mangrove product.

The forest has few other minor products. There are scattered trees which yield gums and resins, but none of them occur in sufficient numbers to be of any commercial importance.

Minor products are not included in the concession granted to the Insular Lumber Company. With the exception of Balao, they can best be utilized in satisfying the needs of the surrounding population. Consequently, no special recommendations are made for the regulation of their collection.

AGRICULTURAL POSSIBILITIES OF THE LAND.

Cleared land adjoining the tract, which has the same soil and general characteristics of the more level parts of the forest, is giving good results in agriculture. Sugar cane, hemp, and corn are the principal crops, all of which do well, although the sugar made from cane grown on this soil is discolored and does not bring the best prices. For sugar cane, the land is called third class. Corn grows well and is the chief product of the poor people. At the present time the price of the land is low. Probably considerable areas now covered by cogon grass and brush can be bought at less than ₱20 per hectare.

There are many acres of land on the tract suitable for corn, and a smaller area would give good results in sugar cane. About 300 acres in the northwest corner and in the valley of the Himugaan River are now under cultivation. The exact area of the tract which is better for agricultural uses after being lumbered is not definitely known. There

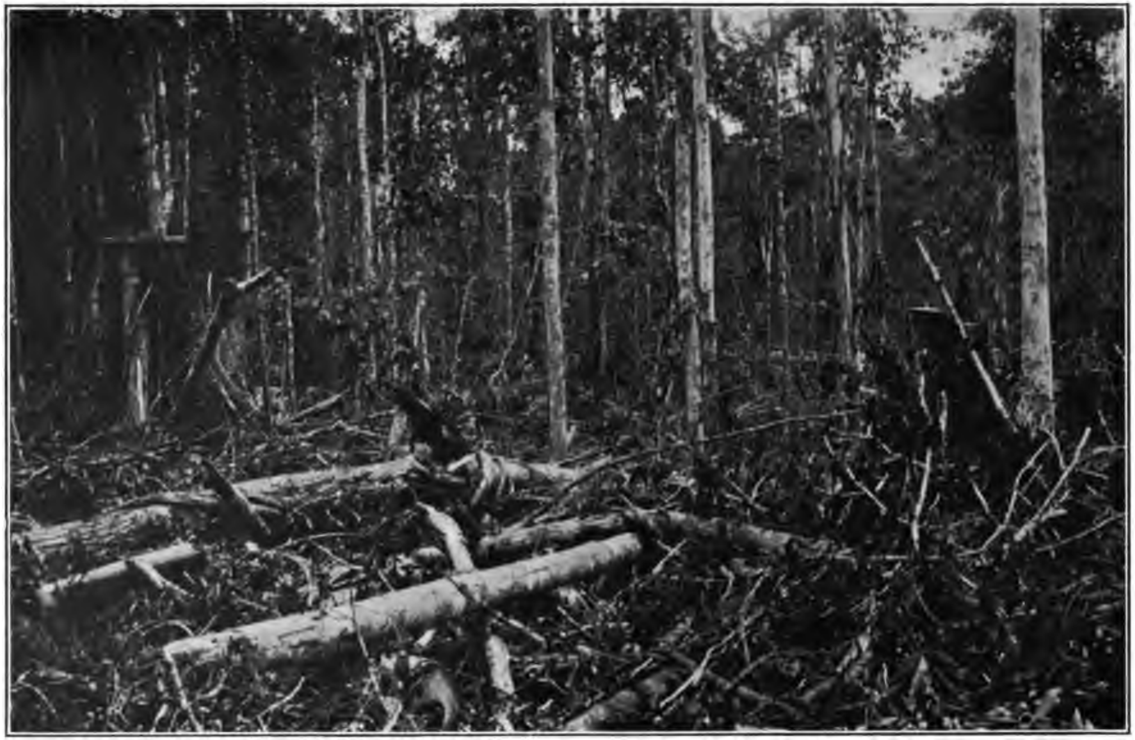

PLATE X. FOREST IN POOR CONDITION AFTER LOGGING.

are probably about 10,000 acres which would be classed as agricultural land, of which about 4,500 acres are either cleared or covered with brush. The largest single area of good agricultural land is in block 7, east of the Himugaan River. All of such land is confined to the northern side of the tract. The upper hilly portion is more valuable for forest than for agricultural purposes.

There is a strong desire for the land among the neighboring people. Often, however, they use poor judgment in selecting their clearings, choosing rough, stony places, when rich level land is available. Land suitable for agriculture should be given to the people for homesteads after it has been logged by the company.

PART II.

FUTURE MANAGEMENT.

BASIS OF PROPOSALS.

RELATION BETWEEN OWNER AND LICENSEE.

The owner of this tract of timber land is the Government of the Philppine Islands. In order to secure a revenue from the heavy stand of timber which is balanced between growth and decay, a license agreement was made with the Insular Lumber Company, permitting that company, under restrictions, to exploit timber on the tract for a period of twenty years. The Government requires that this be done without endangering the future supply of timber from the same forests, unless the land is more suitable for agricultural than for forest purposes, in which case the most benefit will be derived from its use for agriculture. On agricultural land the company should remove the greatest possible amount of merchantable timber before it is turned over to the farmer. On true forest land, which includes most of the tract, they should leave a sufficient number of trees to provide for the future stand and exercise care in the logging in order to prevent the destruction of an unnecessary amount of reproduction and small trees.

The company, on the other hand, must make their enterprise yield a considerable profit in order to repay them for the risk in establishing a modern lumbering operation in a tropical country, where there is no experience of others to assist them in avoiding disastrous mistakes. They have invested a large capital in the enterprise, setting an admirable example for those contemplating entering the lumber business in the Philippine Islands. Consequently many sylvical restrictions suitable and beneficial to the forest can not be imposed without excessive hardship to the company. The restrictions and regulations should be practicable, with due regard for the interests of both the Government and the licensee.

DIVISION OF THE FOREST INTO BLOCKS.

To facilitate the management and protection of the forest, and to make the description of places on the tract more concise and definite, the tract is divided into 8 parts or blocks, which are bounded by the important streams. They are shown on the map and described as follows:

TABLE XV.—*Description of blocks.*

Block.	Situation.	Approximate area.		Remarks.
		Hectares.	Acres.	
1	Southwest corner of the tract between the Talabon River and the boundary.	1,400	3,450	Hilly land; all heavily timbered.
2	Between the Hitalon and Talabon Rivers.	1,800	4,450	Rolling and hilly land; considerable area of grass and brush land; contains barrio of Mabini.
3	Between the Panicion and Hitalon Rivers.	2,100	5,150	Rolling and hilly land, mostly heavily timbered; some agricultural land.
4	Between the Pioc and Himugaan Rivers on the east and the Panicion River on the west.	1,600	3,950	Rolling and hilly upland and some bottom land; clearings, cultivated land, and present cutting area near Himugaan River.
5	Between the Iglumgum and the Malugo Rivers on the east and the Pioc River on the west.	1,200	2,950	Rolling and hilly land, mostly heavily timbered; little agricultural land.
6	Between the Himugaan and the Iglumgum Rivers.	3,600	8,890	Rolling and hilly land, mostly heavily timbered; little agricultural land.
7	Between the Tanao and Himugaan Rivers.	4,400	10,850	Rolling and hilly land, heavily timbered; large area of agricultural land.
8	East end of the tract between the boundary and the Tanao River.	1,900	4,700	Rolling and hilly land, heavily timbered.
	Total	18,000	44,390	

These blocks will furnish a useful basis for future investigations on the tract. The logging operations will probably be confined to blocks 3, 4, and 6 for several years, and consequently should receive as soon as possible a more careful and detailed study than has yet been given to them.

The principal trails in the forest have been surveyed and marks have been placed on them every one-half kilometer from their starting points. Each trail is given a letter—for example, 2 KC means that the mark is on Trail C, 2 kilometers from its beginning. The trails and their marks are on the forest maps. Places in the forest can be located easily and definitely. If a clump of large Apitong trees is discovered, one will pace to the nearest trail, down the trail to the first survey mark, and will then describe the location of the Apitong as follows: Block 4, B. F. 3 KC., S. W. 200 m., S. E. 300 m. The place is then definitely located with few words and can be marked accurately on the forest map. This method of description will be used by forest officers for future work on the tract.

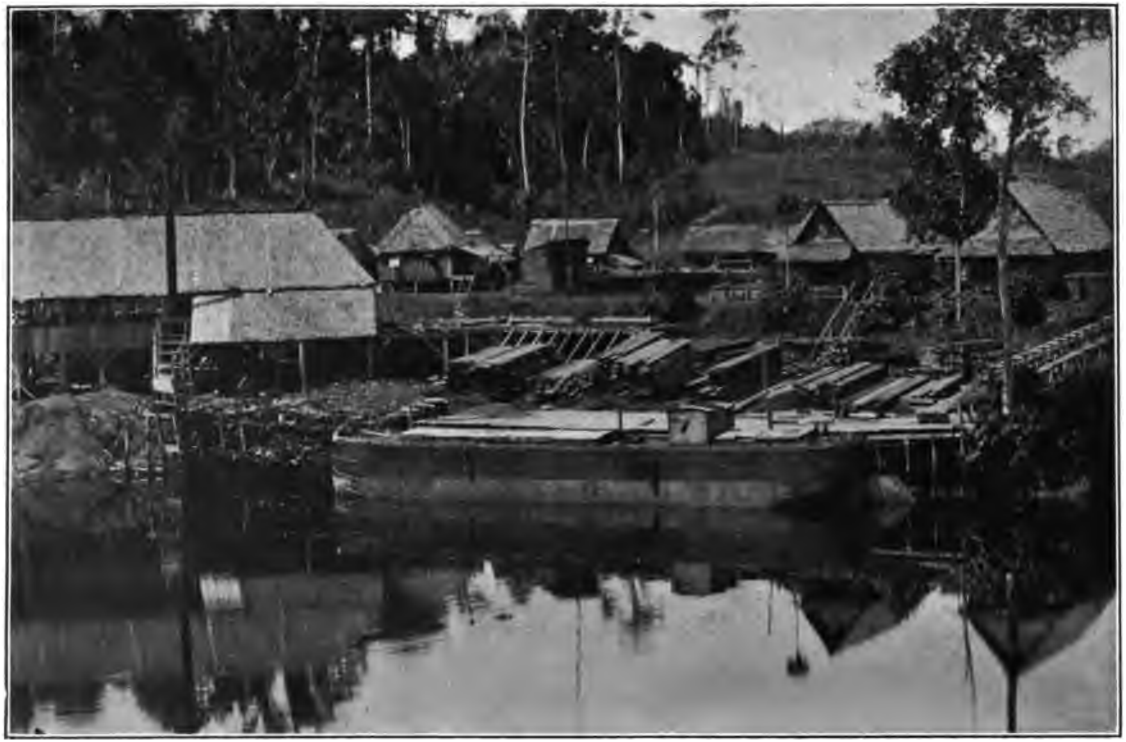

PLATE XI. GENERAL VIEW OF THE SAWMILL SITE. (NOTE LUMBER BARGE IN THE RIVER.)

SUMMARY OF MERCHANTABLE STAND AND YIELD.

The following is a summary of the number of merchantable trees and of the merchantable yield of the six principal species above 40 centimeters (16 inches) and 50 centimeters (20 inches) in diameter, respectively:

Diameter.	Stand.		Yield.	
	Number of trees per acre.	Number of trees per hectare.	Feet, board measure, per acre.	Cubic meters per hectare.
40 centimeters	29.4	72.6	33,450	288.5
50 centimeters	22.3	55.1	32,050	265.9

METHOD OF TREATMENT.

OBJECT TO BE ATTAINED.

The object to be attained is to make the best use of the land and forest by securing the largest possible yield from the latter without inflicting hardship upon the licensee or endangering a future timber crop on the forest land, and by putting the agricultural land to its best use.

METHOD OF TREATMENT ADOPTED.

It is evident that agricultural and nonagricultural lands must receive different treatment. The former will be turned over to the farmer after being logged; the latter will be kept in forest to provide for a future yield.

Agricultural land now covered with merchantable forest will be treated as nearly as possible under a clear cutting system—that is, all merchantable trees will be cut for lumber and as many of the unmerchantable trees as possible for road construction. No care need be taken to protect the reproduction, as the land will be immediately cleared for agriculture. The essential requirement is that no merchantable timber be left on the land. As the logging proceeds, the boundaries of the agricultural land must be determined.

Nonagricultural or forest land will be treated under the selection system, with a continuous yield of the six principal species in view. Care must be taken to leave sufficient small trees and reproduction to provide for the future yield. No provision is advisable at present for a regular rotation and sustained annual yield.

EXPLOITABLE SIZE.

On agricultural land, all trees are exploitable.

On forest land, none of the six principal species must be cut below a certain diameter limit. The diameter limit must be fixed so there will be sufficient seed trees and young growth to secure a good stand of the desired species. There should be as many trees as possible left standing without seriously affecting the merchantable yield. With a diameter limit of 40 centimeters (16 inches) there is a yield of about 33,450 feet B. M. per acre, leaving 28.1 trees per acre 12 to 40 centimeters in diameter. With a diameter limit of 50 centimeters (20 inches), there is a yield of about 32,050 feet B. M. per acre, leaving 35.3 small trees per acre 12 to 50 centimeters in diameter. Cutting to a 50-centimeter limit instead of to a 40-centimeter limit, there is a loss in yield of 1,400 feet B. M. per acre, or 4 per cent, and a gain in small trees of 7.2 per acre, or 25 per cent. The 50-centimeter diameter limit is clearly the better. Moreover, trees below 40 centimeters in diameter would probably not seed well, while trees between 40 and 50 centimeters in diameter would produce considerable seed under the influence of increased light and space. Since a part of the small growth is unavoidably destroyed by the logging, it is all the more necessary to fix the diameter limit higher than 40 centimeters. The company has, however, shown little desire to exploit the trees between 40 and 50 centimeters in diameter, using them only in road construction. Therefore, a 50-centimeter diameter limit will be found practicable. Whether it is sufficiently high to provide for a satisfactory second crop is not certain. It is proposed as a provisional diameter limit until that fact is learned.

THE LOGGING.

CUTTING AREAS.

The areas chosen by the company for exploitation should be selected with the approval of the Bureau of Forestry, to avoid leaving uncut exposed strips of forest. The cutting should proceed as regularly and compactly as possible. It is not deemed advisable, in view of the condition of the forest and other factors, to place any restrictions upon the size of the annual cutting area.

GENERAL CUTTING RULES.

The following cutting rules shall apply to both agricultural and forest lands.

(1) All felling and cutting shall be done with saws as far as possible.

(2) No trees shall be left lodged in the process of felling.

(3) No stumps shall be higher than the principal buttresses.

(4) Defective logs containing 50 per cent or more clear, sound lumber shall be utilized for lumber.

(5) No logs containing 50 per cent or more clear, sound lumber shall be used as fuel for the engines.

(6) No sound logs in the tops of the trees 8 feet and over in length and over 15 inches in diameter shall be left in the woods.

(7) Excessive quantities of timber cut for construction purposes in the forest and wasted shall be manifested and paid for by the company.

(8) Timber wasted in violation of the cutting rules shall be measured by the forest officers and paid for by the company.

ADDITIONAL CUTTING RULES FOR AGRICULTURAL LAND.

(1) Agricultural land shall, as far as possible, be the first to be logged.

(2) All merchantable trees of the six principal species 40 centimeters (16 inches) and over in diameter shall be cut for lumber.

(3) For construction purposes in logging, trees of the minor species and unmerchantable trees of the principal species only shall be used.

(4) Small trees broken down by the large trees in felling shall be utilized.

(5) The railroad ties and skids for use in logging on the forest land shall be taken from the agricultural land whenever possible.

ADDITIONAL CUTTING RULES FOR FOREST LAND.

(1) No Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican, or Lauan-dunlog trees less than 50 centimeters (20 inches) in diameter shall be cut unless they stand in a proposed road, interfering with the logging, unless they have been damaged by the logging, or unless they have been selected for felling by the forester in charge of the district.

(2) No Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican, or Lauan-dunlog trees less than 50 centimeters (20 inches) in diameter shall be used in road or bridge construction unless they stand in a place interfering with the logging, where their removal is necessary.

(3) The workmen must not destroy seedlings or saplings of Apitong, Almon, Balacbacan, Mangachapuy, Lauan-bagtican and Lauan-dunlog.

(4) Care must be taken to prevent fires on the cut-over land during the dry season.

SUPPLEMENTARY RECOMMENDATIONS.

GENERAL MANAGEMENT.

(1) The forest adjoining the tract on the north, which is especially liable to destruction by caiñgins, should be logged as soon as possible by the company under yearly license.

(2) The areas to be logged shall be selected by the company, after securing the approval of the Bureau of Forestry.

(3) Cut-over land suitable for agriculture shall be immediately opened to homestead entry.

(4) The boxing or tapping of the Apitong tree for Balao shall be prohibited on the tract.

(5) The species of timber manufactured by the company shall be

classified in the timber groups to which they properly belong as soon as possible.

(6) The company shall sell manufactured lumber to the residents of the municipalities of Cadiz, Sagay, and Escalante at prices which shall never exceed the wholesale price in Manila, less freight and lighterage.

(7) A ranger employed by the Bureau of Forestry shall be stationed permanently on the concession, whose duties shall be to protect the forest from caiñgins and trespass, to inspect the lumbering operations, and to make forest investigations under the direction of the chief of the forest district.

(8) The stumpage charges will continue to be paid on the manufactured lumber.

PROTECTION.

In order to put the above plan into effect, the forest must be protected before as well as after it is logged. The destruction of standing timber is a loss to the Government as well as to the company, but the loss to the latter is more serious, since such destruction is here confined to the most accessible part of the tract, where the profits from lumbering are correspondingly greater. The production of the future timber crop can not be provided for without protection of the forest, nor can sylvical restrictions be imposed on the company. The necessity and difficulty of protection against caiñgins have been shown in Part I. The benefits of protection being mutual, the company should coöperate with the Bureau of Forestry in carrying out the necessary measures.

The problem is to prevent the caiñgins, because after the damage is done there is no remedy. The following measures are necessary:

(1) The ranger of the Bureau of Forestry stationed on the concession shall engage himself principally with its protection.

(2) The company shall provide him with the necessary assistance to make his work effective.

(3) The ranger shall patrol the concession thoroughly and prevent caiñgins by means of warnings, and arrests if necessary.

(4) The northern boundary of the tract shall be surveyed and marked. Every one-half kilometer a painted board marked with the letters B. F. and the number of kilometers from the starting point should be nailed to a tree. Where trails cross the boundary, warning notices in the Visayan dialect should be posted, stating that caiñgins are prohibited on the tract and that permission to collect forest products must be obtained from the ranger in charge.

(5) The cleared lands within the tract bordering on or surrounded by forest shall be surveyed and marked in order to prevent their extension.

(6) Residents of the towns within which the tract is situated who desired to collect forest products for personal use shall obtain a written

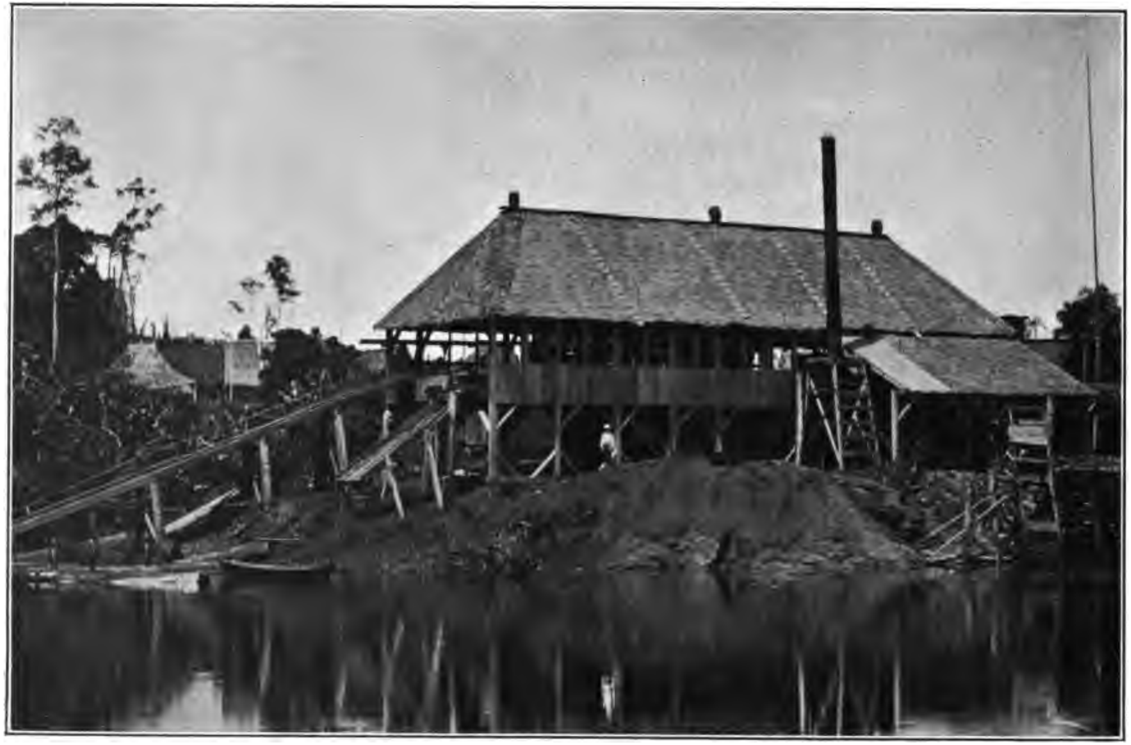

Plate XII. SAWMILL OF THE INSULAR LUMBER COMPANY.

permission from the ranger in charge. Permission should be granted in all such cases, except for Balao.

It is believed that the above measures are practicable and will in a short time bring the caiñgins under control.

REVISION.

This is a preliminary working plan, therefore it will naturally be found inadequate in many ways, and shall be amended from time to time.

ADMINISTRATION.

The forest officers who shall be charged with the administration of the plan shall be the forester in charge of district No. 8 and the ranger stationed permanently on the tract. Action taken by them to enforce the provisions of the plan shall be reported to the Director of Forestry for approval.

The forester in charge of district No. 8 shall have general supervision of the tract and shall make frequent inspections. The ranger stationed on the tract shall have immediate supervision, under the direction of the forester. In matters relating to the protection of the forest from fires and trespass, he shall take the necessary action, promptly reporting the facts to the forester. In matters concerning the compliance of the Insular Lumber Company with the provisions of the working plan, the ranger shall note the facts and report them to the forester. The forester will investigate and, if possible, arrange the matter with the representatives of the company, reporting the results to the Director of Forestry. New regulations and amendments to existing regulations shall be recommended by the forester to the Director of Forestry. The forest officers shall assist the company with information regarding the tract, which they have collected in their investigations. Every effort consistent with the wise use of the forest products on the tract should be made by the forest officers to assist the company in making this enterprise a financial success.

The sections relating to cutting rules, management, and administration have been submitted by the Director of Forestry to the Insular Lumber Company for suggestions, and after a discussion of a few features of the working plan, the sections mentioned were, after slight modifications, agreed upon.

APPENDIX.

LIST OF TREE SPECIES.

The following is a list of tree species mentioned in the text and includes, among others, all the commercial species found in merchantable quantities. Botanical specimens of about seventy tree species were collected. While the data at hand is too incomplete to make an estimate of the total number of tree species on the area, yet compared with other forests in the Philippines already examined, this one has a comparatively simple floristic composition. On the other hand, contrasted with the average hardwood forest of the temperate zone, it is more complex. It will be seen from the stand and yield tables that the six species of *Dipterocarpaceæ* are so far ahead of all others, both in number of trees and bulk of wood, that this may be regarded as a pure Dipterocarp forest. From a lumberman's standpoint, the yield of timber in this forest is equal to, or exceeds, the best American hardwood forest, and compares favorably with the best coniferous forests of the eastern United States.

At present there is much confusion among the commercial timbers in the Philippines, which can not be avoided until more is known about them. A number of species are placed on the market under one name, and sometimes the same species has several different market names. For the sake of comparison, the fourth column of the list gives the known names under which the species are sold in the Manila market.

The authors wish to express their thanks to Elmer D. Merrill, botanist, Bureau of Science, for assistance in the identification of the botanical material.

List of the species mentioned in the text.

Scientific name.	Family.	Local common name.	Commercial name.
Astronia cumingiana Vid.	Melastomaceæ		
Breynia rhamnoides Muell-Arg.	Euphorbiaceæ	Tulug-tulug	
Canarium sp.	Burseraceæ	Moabog	
Diospyros sp.	Ebenaceæ	Ata-ata	Bolongeta.
Dipterocarpus grandiflorus Blanco.	Dipterocarpaceæ	Apitong	Apitong.
Eugenia sp.	Mrytaceæ	Bulog	
Ficus haulli Blanco	Moraceæ	Labnug	
Homalanthus populneus Pax.	Euphorbiaceæ	Balanti	
Hopea philippinensis Dyer	Dipterocarpaceæ	Guisoc-guisoc	
Kayea sp.	Guttiferæ		
Livistona sp.	Palmæ	Anahao	Palma brava.

List of the species mentioned in the text—Continued.

Scientific name.	Family.	Local common name.	Commercial name.
Mallotus ricinoides Muell-Arg.	Euphorbiaceæ	Himlaamo	
Oncosperma sp.	Palmæ		
Pandanus sp.	Pandanaceæ	Pandan	
Pinanga sp.	Palmæ		
Psidium guayava L.	Myrtaceæ	Bayabas	
Shorea contorta Vid.	Dipterocarpaceæ	Lauan-dunlog	White Lauan.
Shorea polysperma Merr.	do	Balacbacan	Balacbacan, Tanguile, Red Lauan.
Shorea sp.	do	Mangachapuy	Red Lauan, Balacbacan.
Shorea sp.	do	Lauan-bagtican	White Lauan.
Shorea squamata Dyer	do	Almon	Do.
Trema amboinensis Blume	Tiliaceæ	Janagdon	
Vitex aherniana Merr.	Verbenaceæ	Dungula	Sasalit.

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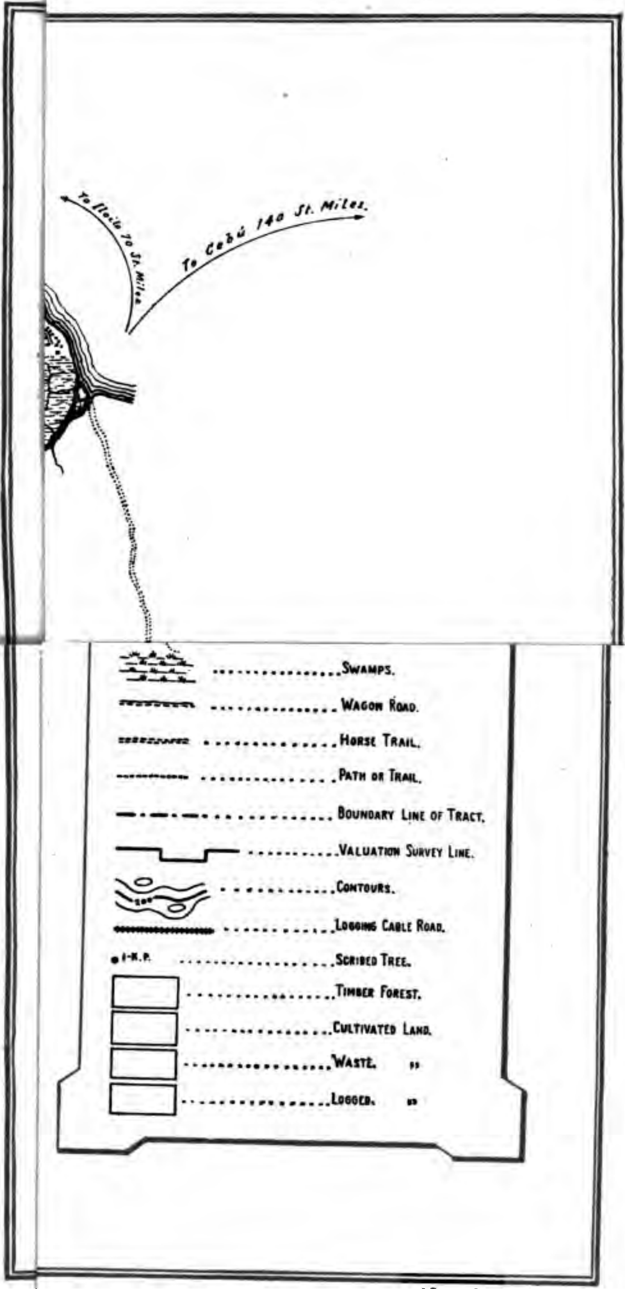
To Iloilo 70 St. Miles
To Cebú 140 St. Miles.
Swamps.
Wagon Road.
Horse Trail.
Path or Trail.
Boundary Line of Tract.
Valuation Survey Line.
Contours.
Logging Cable Road.
I-K.P.
Scribed Tree.
Timber Forest.
Cultivated Land.
Waste. "
Logged. "

J. Castro Del.

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